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Uncut Roux-en-Y Reconstruction after Laparoscopic Distal Gastrectomy Can Be a Favorable Method in Terms of Gastritis, Bile Reflux, and Gastric Residue

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Purpose: Laparoscopic distal gastrectomy (LDG) is a well-established procedure for the treatment of early gastric cancer. Several reconstruction methods can be adopted after LDG according to tumor characteristics and surgeon preference. This study aimed to compare the remnant gastric functions after different reconstructions.

Materials and Methods: In total, 221 patients who underwent LDG between March 2005 and October 2013 were reviewed retrospectively. The patients were classified into four groups based on the reconstructive procedure: Billroth I (BI) anastomosis, Billroth II (BII) with Braun anastomosis, Roux-en-Y (RY) reconstruction, or uncut RY reconstruction. Patient demographics, surgical outcomes, and postoperative endoscopic findings were reviewed and compared among groups.

Results: Endoscopic evaluations at 11.8±3.8 months postoperatively showed less frequent gastritis and bile reflux in the remnant stomach in the RY group compared to the BI and BII groups. There was no significant difference in the gastric residue among the BI, BII, and RY groups. The incidence of gastritis and bile reflux in the uncut RY group was similar to that in the RY group, while residual gastric content in the uncut RY group was significantly smaller and less frequently observed than that in the RY group (5.8% versus 35.3%, P=0.010).

Conclusions: RY and uncut RY reconstructions are equally superior to BI and BII with Braun anastomoses in terms of gastritis and bile reflux in the remnant stomach. Furthermore, uncut RY reconstruction showed improved stasis compared to conventional RY gastrojejunostomy. Uncut RY reconstruction can be a favorable reconstructive procedure after LDG.

Key Words: Stomach neoplasms; Gastrectomy; Reconstructive surgical procedures; Anastomosis, Roux-en-Y; Bile reflux

Introduction

Gastric cancer is the most common cancer and the second most common cause of cancer deaths in Korea.[1] Early gastric cancer (EGC) accounts for >50% of all gastric cancer cases in Korea owing to early detection on nationwide screening; consequently, the overall survival rates of patients with gastric cancer have markedly improved over the past few decades.[2,3] Quality of life after surgery has become an important issue in these patients in Korea.

Laparoscopic distal gastrectomy (LDG) is already a well-established procedure for EGC treatment. Many previously published studies demonstrated its feasibility and oncologic safety as well as better quality of life with minimal invasiveness compared to conventional open surgery.[4-6] However, many patients still experience post-gastrectomy symptoms including malabsorption, dumping syndrome, alkaline reflux, and delayed gastric emptying even after laparoscopic surgery; these symptoms originate from the inevitable anatomic deviation encountered during surgical procedures. Additionally, detection of metachronous cancer in the remnant

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stomach in patients after distal gastrectomy has increased owing to prolonged survival. Therefore, surgeons are seeking a better reconstruction method that features better long-term quality of life and reduces the risk of remnant gastric cancer after distal gastrectomy. The reconstruction method used after LDG might vary according to tumor characteristics or surgical conditions, but this seems to largely depend on the surgeons' preferences. We assumed that reconstruction type following distal gastrectomy would influence remnant gastric function and quality of life after surgery.

The current study aimed to compare the different reconstructive procedures after LDG in terms of surgical outcomes, remnant gastric function, and postoperative nutritional status.

Materials and Methods

A review of the prospectively established gastric cancer database identified 211 patients who underwent LDG for histopathologically confirmed gastric cancer between March 2005 and October 2013 at our institution; the medical records of these patients were reviewed retrospectively. All patients were evaluated preoperatively with endoscopy and abdominal computed tomography to predict the disease extent. Laparoscopic surgery was offered to those patients who were clinically diagnosed with stage IA or IB gastric cancer according to the seventh edition of the American Joint Committee on Cancer staging system.[7]

The patients underwent either laparoscopy-assisted distal gastrectomy (LADG) or totally laparoscopic distal gastrectomy (TLDG) along with D1+ or greater lymphadenectomy. A single surgeon performed all surgical procedures. The LDG procedures have been previously described in detail.[8,9] The tumor location largely influenced the decision between Billroth I and Billroth II reconstructions when extracorporeal anastomosis was used before 2008. When TLDG with intracorporeal anastomosis was adopted thereafter, the reconstruction method was selected based on the surgeon's temporary preference among Billroth II with Braun, Roux-en-Y, and uncut Roux-en-Y reconstructions without distinct indications. The patients were classified into four groups according to the reconstruction method used: Billroth I gastroduodenostomy (BI), Billroth II gastrojejunostomy with Braun anastomosis (BII), Roux-en-Y gastrojejunostomy (RY), and uncut Roux-en-Y reconstruction (uncut RY). The clinical data and surgical outcomes were compared among the groups.

1. Perioperative data

Demographics, clinicopathological characteristics, surgical outcomes, and follow-up data were obtained from the medical records for the analyses. Patient surgical risk was assessed preoperatively according to the American Society of Anesthesiologists classification as follows: I, healthy patient; II, mild systemic disease; III, severe systemic disease; IV, severe systemic disease that is a constant threat to life; and V, moribund patient unlikely to survive 24 hours with or without operation.[10] The operating time was defined as the time from skin incision to wound closure, while intraoperative blood loss was estimated from the amount of blood suctioned from

Table 1. The residue, gastritis, bile classification

Residual food	
Grade 0	No residual food
Grade 1	A small amount of residual food
Grade 2	A moderate amount of residual food, but possible to observe entire surface of the remnant stomach with body rolling
Grade 3	A moderate amount of residual food, hindering observation of the entire surface even with body rolling
Grade 4	A large amount of residual food, making endoscopic observation impossible
Gastritis (degree)	
Grade 0	Normal mucosa
Grade 1	Mild redness
Grade 2	Intermediate grade between grade 1 and grade 3
Grade 3	Severe redness
Grade 4	Apparent erosion
Bile reflux	
Grade 0	Absent
Grade 1	Present

the operative field as described on the anesthetic chart. Postoperative complication severity was classified according to the Accordion Severity Grading System of Postoperative Complications.[11] Clinical stasis was diagnosed when the patient did not tolerate the diet progression as scheduled in the early postoperative period and required fasting or a clear liquid diet for >2 days after diet progression.

The neutrophil-lymphocyte ratio (NLR) was calculated to assess the systemic inflammatory response during the early postoperative period, and the changes were compared among groups to evaluate the differences in systemic inflammatory responses after using the different reconstruction methods.

2. Nutritional status

Body weight and serum hemoglobin, total protein, and albumin levels were collected retrospectively to investigate the changes in nutritional status after different reconstruction methods were performed. Postoperative values at 1 year of follow-up were retrieved, and the relative values to the preoperative levels were calculated to compare the outcomes.

3. Classification of endoscopic findings

The patients received follow-up upper gastrointestinal endoscopy 1 year postoperatively. An experienced gastroenterologist reviewed the endoscopic findings retrospectively. Gastric residue, degree of gastritis, and bile reflux in the remnant stomach were evaluated using the endoscopic 'residue, gastritis, bile' (RGB) classification proposed by Kubo et al.[12] The detailed classification of endoscopic findings in the remnant stomach is shown in Table 1. According to the RGB classification, higher scores indicate worse symptoms or signs in the remnant stomach.

4. Statistical analysis

All statistical analyses were performed using SPSS ver. 14 for Windows (SPSS Inc., Chicago, IL, USA). All values are expressed as mean±standard deviation. Either the Pearson χ^2 test or the Fisher's exact test was used to compare categorical variables. The mean difference among the four groups was analyzed using a one-way analysis of variance, and multiple comparisons using the Tukey honestly significant difference test were conducted post hoc to assess differences between pairs of groups. Two-sided P-values were calculated for all tests, and P-values <0.05 were considered statistically significant.

Table 2. Clinicopathologic characteristics of the patients (n=211)

Variable	Value
Age (yr)	57.6±11.9
Sex	
Male	126 (59.7)
Female	85 (40.3)
BMI at operation (kg/m^2)	24.4±3.5
History of previous abdominal surgery	7 (3.3)
History of endoscopic resection	19 (9.0)
ASA score	
I	105 (49.8)
II	104 (49.3)
III	2 (0.9)
Operation	
LADG	77 (36.5)
TLDG	134 (63.5)
Extent of lymph node dissection*	
D1+	181
D2	11
Reconstruction	
Billroth I	39 (18.5)
Billroth II	76 (36.0)
Roux-en-Y	55 (26.1)
Uncut Roux-en-Y	41 (19.4)
Combined operation	26 (12.3)
Cholecystectomy	13
Colorectal surgery	4
Therapeutic endoscopy	4
Miscellaneous	5
Laparotomic conversion	1 (0.5)
Number of retrieved lymph nodes	24.7±12.6
Pathologic stage†	
0	3 (1.4)‡
IA	177 (83.9)
IB	19 (9.0)
IIA	10 (4.7)
IIB	1 (0.5)
IIIA	1 (0.5)

Values are presented as mean±standard deviation, number (%), or number only. BMI = body mass index; ASA = American Society of Anesthesiologists; LADG = laparoscopy-assisted distal gastrectomy; TLDG = totally laparoscopic distal gastrectomy. *Extent of lymph node dissection following the Japanese gastric cancer treatment guidelines 2010. †Pathological stage according to the seventh edition of the American Joint Committee on Cancer staging manual. ‡Three patients, who were preoperatively diagnosed with gastric cancer by endoscopic biopsy, were proved to have tubular adenoma with high-grade dysplasia after surgery.

Results

The patients' clinicopathological characteristics are shown in Table 2. The mean patient age was 57.6±11.9 years, and the population included 126 men (59.7%) and 85 women (40.3%). Nineteen patients had a history of endoscopic resection for gastric cancer lesions, and they were referred to the surgical department because of lymph node metastasis risk or complications during endoscopic procedures.

Seventy-seven patients underwent LADG and the other 134 underwent TLDG. The most commonly used reconstruction method was BII anastomosis (76/211, 36.0%), followed by conventional RY reconstruction (55/211, 26.1%). Braun anastomosis was performed in all but 3 patients who underwent BII reconstruction.

1. Perioperative surgical outcomes

The surgical outcomes were compared among the different reconstruction groups (Table 3). All patients in the BI group underwent LADG contrary to the other reconstruction groups (P<0.001). The operating time was significantly prolonged in the RY group (239.5±72.2 minutes), and it was the shortest in the uncut RY group (187.3±56.1 minutes, P=0.004). Blood loss was the lowest in the uncut RY group (186.8±119.1 ml) and the highest in the BI group (391.6±237.3 ml, P<0.001). When the differences between the conventional RY and uncut RY groups were further analyzed, surgical outcomes including operating time and blood loss in the uncut RY group were significantly better than those in the RY group (P=0.003 and P<0.001, respectively). The mean hospital stay was similar between the groups.

One patient in the BII group underwent laparotomic conversion for intraoperative bleeding from the right gastric artery. Severe postoperative complications requiring invasive intervention developed in 2 patients in the RY group and in 1 patient in the uncut RY group; 2 patients with intra-abdominal bleeding and an incisional hernia in the RY group required reoperation, while 1 in the uncut RY group who presented with intraluminal bleeding underwent endoscopic intervention. However, the overall incidence and distribution of complication severity did not differ statistically among the groups (P=0.399). Clinical stasis occurred in 15 of 211 patients in the early postoperative period, and the incidence was similar among the groups (P=0.489).

Regarding the postoperative systemic inflammatory response measured by NLR, the RY group showed a greater increase in the ratio compared to the other groups on the first postoperative day

Table 3. Comparison of surgical outcomes according to the reconstructive procedures

	BI (n=39)	BII (n=76)	RY (n=55)	Uncut RY (n=41)	P-value*	P-value†
LADG : TLDG (no. of cases)	39 : 0	29 : 47	7 : 48	2 : 39	<0.001§	0.293‖
Operating time (min)‡	202.2±53.3[a]	210.2±84.2[a,b]	239.5±72.2[b]	187.3±56.1[a]	0.004¶	0.003**
Intraoperative blood loss (ml)‡	465.6±219.8[a]	275.7±279.0[b,c]	391.6±237.3[a,b]	186.8±119.1[c]	<0.001¶	<0.001**
No. of retrieved lymph nodes‡	21.1±10.0[a]	23.4±13.4[a,b]	27.9±12.2[b]	26.3±13.1[a, b]	0.040¶	0.925**
Length of hospital stay (d)	9.8±4.5	8.6±5.5	8.4±4.3	8.3±4.7	0.444¶	0.925**
Intraoperative complications	0	1	0	0	>0.999§	
Postoperative complications					0.399‖	0.347‖
No	33 (84.6)	63 (82.9)	40 (72.7)	34 (82.9)		
Yes						
Mild	6 (15.4)	12 (15.8)	12 (21.8)	4 (9.8)		
Moderate	0 (0)	1 (1.3)	1 (1.8)	2 (4.9)		
Severe	0 (0)	0 (0)	2 (3.6)	1 (2.4)		
Gastric stasis	4 (10.3)	3 (3.9)	5 (9.1)	3 (7.1)	0.489‖	>0.999‖

Values are presented as ratio, mean±standard deviation, number only, or number (%). BI = Billroth I gastroduodenostomy; BII = Billroth II gastrojejunostomy; RY = Roux-en-Y reconstruction; LADG = laparoscopy-assisted distal gastrectomy; TLDG = totally laparoscopic distal gastrectomy. *Statistical significances among groups; †statistical significances between RY vs. uncut RY groups. ‡The same superscript letters indicate insignificant difference between groups based on the Tukey multiple comparison test. §Pearson's chi-square test. ‖Fisher's exact test. ¶One-way analysis of variance. **Multiple comparison with Tukey honestly significant difference test.

(P=0.003), especially the BI group, and the ratio was still significantly higher a week after the surgery (P=0.005; Fig. 1).

2. Outcomes at the 1-year follow-up

There were no significant differences in body weight change among the reconstructive procedures at 1 year after surgery. The nutritional status was assessed using the relative values to the preoperative hemoglobin, protein, and albumin levels, and the changes were not significantly different among the groups (Table 4).

Remnant gastric function was evaluated considering the endoscopic findings, and 177 patients (83.9%) received follow-up endoscopy 1 year postoperatively. The mean interval between surgery and endoscopic surveillance was 11.8±3.8 months. The overall incidences of gastric stasis, gastritis, and bile reflux after LDG were 27.1%, 54.2%, and 23.7%, respectively (Table 5). There was a significant correlation between bile reflux and gastritis (P<0.001); when bile reflux was observed, 88.1% of the patients showed a certain degree of gastritis (Table 6).

Remnant gastric function was further compared considering the reconstructive procedure. There was no significant difference in the amount of gastric residue between the BI (15/32, 46.9%), BII (13/60, 21.7%), and RY (18/51, 35.3%) groups, but the uncut RY group showed significantly improved stasis compared to the BI and RY groups; residual food was detected only in 2 of 34 patients (5.8%) who underwent uncut RY reconstruction and were followed-up endoscopically (Fig. 2A). Gastritis in the RY (15/51, 29.4%) and uncut RY (9/34, 26.5%) groups was equally less severe and less frequently observed than that in the BI (27/32, 84.4%) or BII (45/60, 75.0%) groups (Fig. 2B). Bile reflux also was less frequently detected in the RY (5/51, 9.8%) and uncut RY (0/34, 0%) groups than in the BI (11/32, 34.4%) and BII (26/60, 43.3%) groups (Fig. 2C).

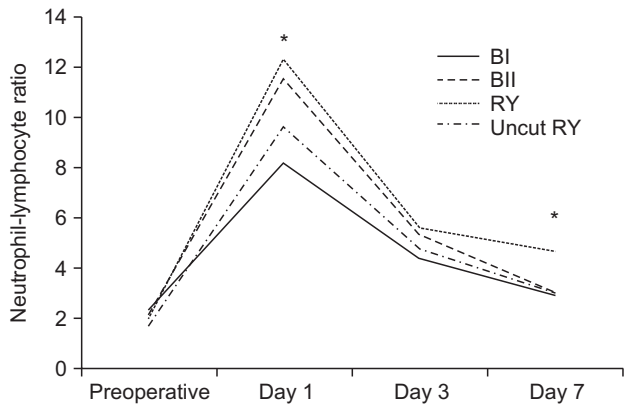

Fig. 1. Systemic inflammatory response after surgery according to the reconstructive procedures. BI = Billroth I gastroduodenostomy; BII = Billroth II gastrojejunostomy; RY = Roux-en-Y reconstruction. *P<0.05; by one-way analysis of variance.

Discussion

After distal gastrectomy, several reconstruction methods are available, and preferences vary among surgeons. Controversy remains regarding which method is the best after distal gastrectomy. BI gastroduodenostomy is the only way to preserve the physiological continuity of the gastrointestinal tract, and it has been preferred owing to its technical simplicity during open surgery. However, the risk of anastomosis failure is known to be higher, and the surgical technique could be rather challenging during laparoscopic surgery. BII gastrojejunostomy enables wide stomach resection without anastomotic tension and is relatively easy during laparoscopic surgery; however, postoperative bile reflux into the remnant

Table 4. Change in nutritional status at 1 year postoperatively

	BI (n=39)	BII (n=76)	RY (n=55)	Uncut RY (n=41)	P-value*
Follow-up rate	33 (84.6)	64 (84.2)	51 (92.7)	35 (85.4)	
Time interval (mo)†	11.4±4.4[a,b]	10.9±3.6[a]	12.3±3.4[a,b]	12.9±2.2[a,b]	0.028
Body weight (%)‡	93.0±6.8	91.3±6.9	90.0±7.3	90.4±8.6	0.559
Laboratory results‡					
Hemoglobin (%)	95.0±9.2	97.6±11.3	94.3±9.4	96.1±8.5	0.328
Protein (%)	99.8±9.2	101.5±6.6	98.5±7.1	100.7±7.2	0.180
Albumin (%)	102.5±10.3	103.8±6.7	101.6±9.9	103.2±9.2	0.638

Values are presented as number (%) or mean±standard deviation. BI = Billroth I gastroduodenostomy; BII = Billroth II gastrojejunostomy; RY = Roux-en-Y reconstruction. *One-way analysis of variance. †The same superscript letters indicate insignificant difference between groups based on the Tukey multiple comparison test. ‡Comparison with relative values to preoperative levels.

Table 5. Incidence of gastric stasis, gastritis, and bile reflux (n=177)

	Residual food	Gastritis	Bile reflux
Severity*			
Grade 0	129 (72.9)	81 (45.8)	135 (76.3)
Grade 1	23 (13.0)	61 (34.5)	42 (23.7)
Grade 2	13 (7.3)	25 (14.1)	
Grade 3	5 (2.8)	10 (5.6)	
Grade 4	7 (4.0)		
Overall incidence	48 (27.1)	96 (54.2)	42 (23.7)

Values are presented as number (%). *The severity was classified according to the endoscopic 'residue, gastritis, bile' classification proposed by Kubo et al.[12]

Table 6. Correlation between bile reflux and the degree of gastritis (n=177)

		Bile reflux		P-value
		Grade 0	Grade 1	
Gastritis	Grade 0	76 (56.3)	5 (11.9)	<0.001
	Grade 1	40 (29.6)	21 (50.0)	
	Grade 2	14 (10.4)	11 (26.2)	
	Grade 3	5 (3.7)	5 (11.9)	
Total		135 (100)	42 (100)	

Values are presented as number (%).

stomach is bothersome, and although rare, afferent loop syndrome can develop. RY gastrojejunostomy is known to prevent bile reflux, but the high incidence of Roux stasis syndrome is one of its major drawbacks.[13]

According to a nationwide survey conducted in 2009 in Korea, BI was the most frequently adopted reconstruction after distal gastrectomy (63.4%), followed by BII reconstruction (33.1%); RY reconstruction was seldom performed and comprised only 3.3%.[3] This finding is probably because BI reconstruction is considered simple and safe owing to the use of mechanical staplers, particularly during open surgery, and BII reconstruction serves as an alternative when BI reconstruction is not applicable. In Japan, on the other hand, the most common method of reconstruction was BI, followed by RY. The popularity of RY reconstruction seems to have increased recently owing to its low complication rate and ability to prevent postoperative bile reflux.[14] In the survey, it was revealed that the incidence of Roux stasis reached 71%.

Uncut RY reconstruction was first devised with the purpose of

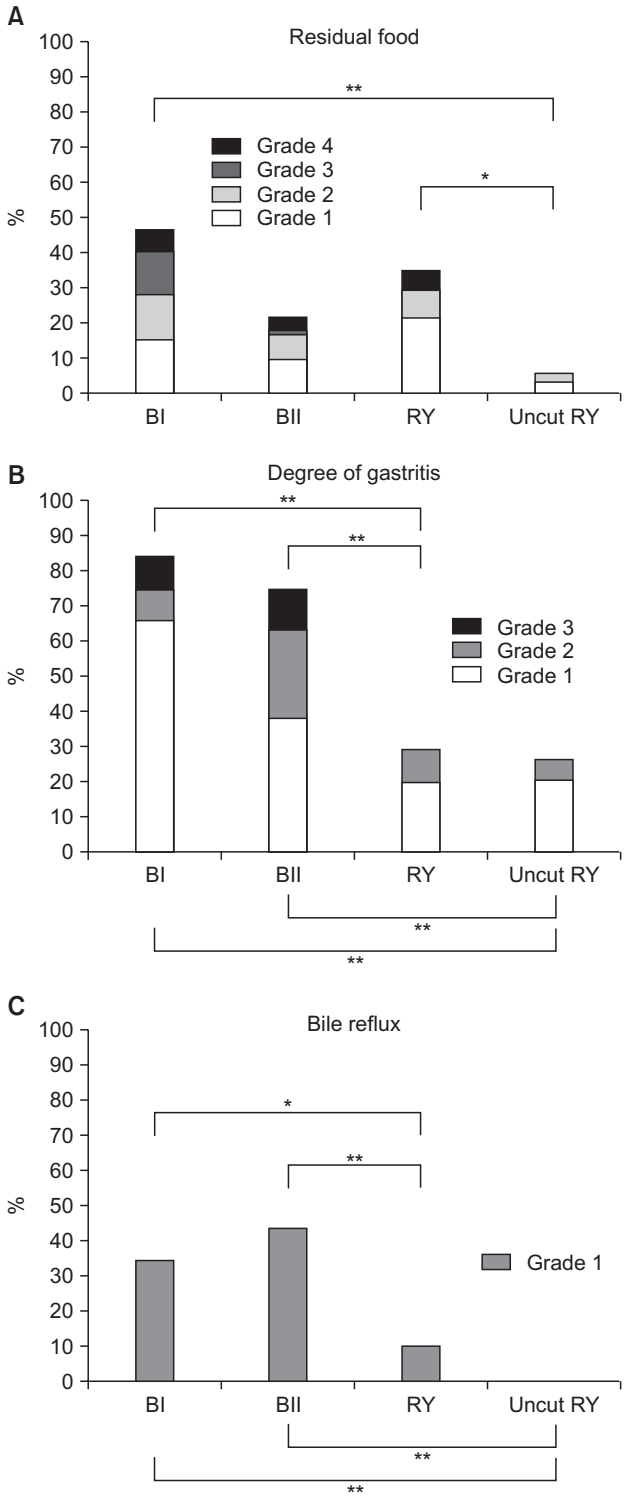

Fig. 2. Comparison of endoscopic findings after different reconstruction methods following laparoscopic distal gastrectomy: residual food (A), degree of gastritis (B), and bile reflux (C). BI = Billroth I gastroduodenostomy; BII = Billroth II gastrojejunostomy; RY = Roux-en-Y reconstruction. *P<0.05; **P<0.005 by Pearson's chi-square test or Fisher's exact test.

preventing Roux stasis syndrome.[15] Uncut RY is a simple modification of the BII with Braun anastomosis method in which the jejunogastric pathway is occluded with a non-bladed linear stapler. It is known to reduce Roux stasis syndrome by maintaining the integrity of the intestinal canal and allowing normal conduction of the myenteric impulses.[16,17] However, the original uncut technique was associated with a high rate of recanalization of the uncut stapled line.[17,18] In the present study, a 6-row linear stapler was used to minimize the risk of staple line dehiscence, and no recanalization was noticed on endoscopic evaluation at 1 year. A longer follow-up period would be required to evaluate the exact incidence of staple line dehiscence.

The operating time was the shortest in the uncut RY group, and it was significantly prolonged in the RY group. Blood loss was the lowest in the uncut RY group and the highest in the BI group. This might be attributable to the difference in surgical experience, as BI was only used during the period of laparoscopy-assisted laparoscopic surgery and it was never adopted after the surgical skill had evolved towards total laparoscopic surgery with intracorporeal anastomosis. Nonetheless, the application of BII, RY, and uncut RY reconstructions was contemporaneous, and uncut RY reconstruction shows at least comparable surgical outcomes to those of BII and RY reconstructions. The operative procedures of uncut RY reconstruction resemble those of BII with Braun anastomosis, and they are less complicated than those of conventional RY reconstruction; this seems to be associated with a lower incidence of complications such as bleeding or gastric stasis than conventional RY reconstruction, although the difference was not statistically significant.

NLR represents an easily measured, reproducible, and inexpensive marker of systemic inflammation that reflects the degree of surgical stress and helps identify patients at high risk of postoperative complications.[19,20] NLR is also known to be associated with oncological outcomes in multiple malignancies, including colorectal and gastric cancers.[21-24] In the present study, the RY group exhibited the highest surgical stress, and patients in this group recovered the slowest over a week among all four reconstructive procedures. The uncut RY group showed relatively reduced systemic inflammation compared to the conventional RY group; this might be related to the decreased intraabdominal organ manipulation during the surgery in order to avoid additional mesenteric division of the proximal jejunum for establishing the Roux limb. Interestingly, the BI group showed the lowest NLR despite losing the most blood and all BI anastomoses being established extracorporeally, which is considered more invasive than the intracorporeal method. The surgeon's familiarity with the procedure, the physiological integrity, and fewer anastomoses could have relieved the surgical stress. The long-term influence of these factors on oncological outcomes requires further investigation in the future.

Regarding postoperative nutritional status, all reconstructive procedures showed similar changes in body weight as well as serum hemoglobin, albumin, and protein levels. Nutritional demerits of the RY method compared to the BI method, which might occur because of the non-physiological food passage, could not be demonstrated in the current study with a 1-year follow-up. This finding is consistent with the results of previous reports that short and long-term nutritional status estimated by considering body weight and serum albumin and total cholesterol levels was similar after RY and BI reconstructions.[25-27] It might be necessary to evaluate other nutritional indexes including various kinds of micronutrients to assess the impact of food bypass after the RY procedure.

Bile reflux into the remnant stomach and esophagus can cause gastritis or esophagitis, and it might increase the risk of cancer development in the remnant stomach and lower esophagus. Although the exact mechanisms for this are not yet clearly understood, many investigators have asserted that the refluxate of duodenal content is directly related to the development of Barrett esophagus and esophageal cancer.[28,29] Duodenogastric reflux has also been suggested as a causal factor of gastric carcinogenesis in numerous experimental models despite scarce human data.[30,31] Furthermore, bile reflux can cause clinical symptoms such as heartburn or regurgitation, impairing patient quality of life and requiring prolonged medical therapy. Takiguchi et al.[32] reported that reflux symptoms were significantly worse after BI than after RY anastomosis according to the questionnaire survey, although BI and RY reconstructions featured equivalent short-term quality of life. As the number of patients with EGC is increasing and survival after treatment is expected to be longer, the issue of metachronous cancer development or postoperative quality of life should be carefully considered when the reconstructive procedure is chosen.

Many studies, particularly those from Japan, have advocated RY over BI reconstructions in terms of avoiding duodenogastric reflux.[26,27] Braun anastomosis was once used in an attempt to divert duodenal content away from the remnant stomach and esophagus,[33] but this was proven ineffective by some authors.[34,35] The current study also showed that bile reflux was present in the remnant stomach in 43.3% of patients after BII with Braun anastomosis, which was an even worse rate than the 33.3% seen after BI reconstruction. For now, RY reconstruction appears to be the most ef-

fective way to prevent bile reflux after distal gastrectomy. However, many surgeons reportedly experienced gastric stasis after the RY procedure.[14,25] The clinical symptoms from Roux stasis could have a negative influence on dietary habits and, consequently, impair patient quality of life. The present study demonstrated that uncut RY reconstruction could evidently resolve gastric stasis, a major disadvantage of RY reconstruction, as expected. Maintaining intestinal continuity without mesenteric division could facilitate bowel peristaltic movement and reduce gastric residue. Furthermore, uncut RY reconstruction showed a relatively lower incidence of bile reflux compared to conventional RY reconstruction despite the same length of the Roux limb, although it was not statistically different; enhanced antegrade peristalsis in the uncut Roux limb might be associated with reduced bile reflux into the remnant stomach.

Admittedly, the current study has several limitations. First, it is based on the retrospective analysis of cases with reconstructive procedures chosen based on surgeon preference and availability, which could have produced a bias. Second, the difference in surgical experience among reconstructive procedures could have resulted in deviation of the results, and the reconstruction approach (intracorporeal or extracorporeal) was not uniform. As such, a well-designed randomized clinical trial is needed to elucidate the definite superiority of a certain reconstruction method after distal gastrectomy.

In conclusion, RY and uncut RY reconstructions are equally superior to BI and BII reconstructions in terms of gastritis and bile reflux in the remnant stomach after LDG. Furthermore, uncut RY reconstructions showed improved stasis compared to conventional RY reconstructions. Therefore, uncut RY can be a favorable reconstruction method after LDG.

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