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ORIGINAL ARTICLE

Observational Study

Assessing optimal Roux-en-Y reconstruction technique after total gastrectomy using the Postgastrectomy Syndrome Assessment Scale-45

Masami Ikeda, Masashi Yoshida, Norio Mitsumori, Tsuyoshi Etoh, Chikashi Shibata, Masanori Terashima, Junya Fujita, Kazuaki Tanabe, Nobuhiro Takiguchi, Atsushi Oshio, Koji Nakada

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Abstract

BACKGROUND

Following a total gastrectomy, patients suffer the most severe form of postgastrectomy syndrome. This is a significant clinical problem as it reduces quality of life (QOL). Roux-en-Y reconstruction, which is regarded as the gold standard for post-total gastrectomy reconstruction, can be performed using various techniques. Although the technique used could affect postoperative QOL, there are no previous reports regarding the same.

AIM

To investigate the effect of different techniques on postoperative QOL. The data was collected from the registry of the postgastrectomy syndrome assessment study (PGSAS).

METHODS

In the present study, we analyzed 393 total gastrectomy patients from those enrolled in PGSAS. Patients were divided into groups depending on whether antecolic or retrocolic jejunal elevation was performed, whether the Roux limb was "40 cm", "shorter" (≤ 39 cm), or "longer" (≥ 41 cm), and whether the device used for esophageal and jejunal anastomosis was a circular or linear stapler. Subsequently, we comparatively investigated postoperative QOL of the patients.

RESULTS

Reconstruction route: Esophageal reflux subscale (SS) occurred significantly less frequently in patients who underwent antecolic reconstruction. Roux limb length: "Shorter" Roux limb did not facilitate esophageal reflux SS and somewhat attenuated indigestion SS and abdominal pain SS. Anastomosis technique: In terms of esophagojejunostomy techniques, no differences were observed.

CONCLUSION

The techniques used for total gastrectomy with Roux-en-Y reconstruction significantly affected postoperative symptoms. Our results suggest that elevating the Roux limb, which is not overly long, through an antecolic route may improve patients' QOL.

Key Words: Total gastrectomy; Roux-en-Y; Postgastrectomy syndrome; Quality of life; Postgastrectomy Syndrome Assessment Scale-45

Core Tip: Following a total gastrectomy using various techniques, patients suffer the severe form of postgastrectomy syndrome. We investigated the effect of different techniques in Roux-en-Y reconstruction on postoperative quality of life (QOL) using the Postgastrectomy Syndrome Assessment Scale-45. We analyzed 393 total gastrectomy patients. Esophageal reflux subscale (SS) occurred significantly less frequently in patients who underwent antecolic reconstruction. Shorter Roux limb did not facilitate esophageal reflux SS and somewhat attenuated indigestion SS and abdominal pain SS. Our results suggest that elevating the Roux limb which is not overly long, through an antecolic route may improve patients' QOL.

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INTRODUCTION

Postgastrectomy syndrome is a serious clinical problem that decreases quality of life (QOL) of patients following gastrectomy[1-5]. As postgastrectomy syndrome is the severest form of the side effect following total gastrectomy[1,2,4,5], reducing the incidence of syndrome should be deliberated while choosing the surgical technique. Post-total gastrectomy Roux-en-Y reconstruction (TGRY) is a simple and robust form of reconstruction performed following a total gastrectomy, and it is widely performed and regarded as the gold standard. As laparoscopic surgery is more widely used in recent years, TGRY

techniques have become more diverse now than when open surgery was used[6-12]. Although the differences in techniques appear to affect postoperative QOL, the reasons remain unclear due to lack of sufficient investigation. Therefore, we used Postgastrectomy Syndrome Assessment Scale-45 (PGSAS-45), which has developed for postgastrectomy evaluation, to investigate how TGRY surgical techniques affect postoperative QOL[13].

MATERIALS AND METHODS

Retrieving the questionnaire

A total of 52 institutions participated in this study. A questionnaire was distributed to 2922 patients between July 2009 and December 2010 (Figure 1). Eligibility criteria for patients were as follows: (1) Diagnosis of pathologically-confirmed stage IA or IB gastric cancer[14]; (2) first-time gastrectomy; (3) aged 20-75 years; (4) no history of chemotherapy; (5) no recurrence or distant metastasis indicated; (6) gastrectomy conducted one or more years prior to the enrollment date; (7) performance status (PS) ≤ 1 on the Eastern Cooperative Oncology Group scale[15-17]; (8) full capacity to understand and respond to the questionnaire; (9) no history of other diseases or surgeries which might influence responses to the questionnaire; (10) absence of organ failure or mental illness; and (11) written informed consent. Patients with dual malignancy or concomitant resection of other organs (with co-resection equivalent to cholecystectomy being the exception) were excluded. Of the distributed questionnaires, 2520 (86%) were retrieved; 152 questionnaires were excluded. A total of 2368 questionnaires were analyzed and it was observed that total gastrectomy was performed in 393 patients; all underwent reconstruction using Roux-en-Y method. Questionnaires of these 393 patients were selected for examination in this study.

QOL assessment

PGSAS-45 consists of 45 items, including all eight items of the Short Form General Health Survey (SF-8) [18], all 15 items from the Gastrointestinal Symptom Rating Scale[19], and 22 newly-added items that cover various factors reflecting the postgastrectomy patient's well-being (Table 1)[13].

The following 18 outcome measures were evaluated, each consisting of a single item or an integration of related items from the PGSAS-45: esophageal reflux subscale (SS), abdominal pain SS, meal-related distress SS, indigestion SS, diarrhea SS, constipation SS, dumping SS, total symptom score, ingested amount of food per meal, necessity for additional meals, quality of ingestion SS, ability for working, dissatisfaction with symptoms, dissatisfaction at the meal, dissatisfaction at working and dissatisfaction for daily life SS, and the physical component summary (PCS) and mental component summary (MCS) of SF-8. Percentage changes in body weight (decrease in body weight/preoperative weight) were also determined as an outcome measure. These 19 main outcome measures were scored and classified into three domains: symptoms, living status, and QOL. Higher scores denote better outcomes for the items of PCS, MCS, ingested amount of food per meal, quality of ingestion SS, and changes in body weight, whereas lower scores denote better outcomes for the other 14 outcome measures.

Postoperative follow-up with PGSAS-45

The gastrectomy patients were provided with a PGSAS-45 questionnaire by the surgeon during an outpatient visit. Each patient was asked to complete the questionnaire and mail it to the data center. The clinical data were reported to the data center by the responsible surgeons using case report form and matched to PGSAS-45 responses. All the data were analyzed at the data center. Postgastrectomy daily living was compared among: (1) Elevated route of Roux limb: antecolic *vs* retrocolic; (2) length of the Roux limb (defined as the distance from esophagojejunostomy to jejunojejunostomy): "shorter (≤ 39 cm)" *vs* "40 cm" *vs* "longer (≥ 41 cm)"; and (3) anastomotic procedure for esophagojejunostomy: circular stapler (CS) *vs* linear stapler (LS) (Figure 2). The study protocol was approved by the institutional review board of each participating institution and registered with the University Hospital Medical Information Network's Clinical Trials Registry (registration number, 000002116). All patients provided their written informed consent for the confidential use of their information in the data analysis, in compliance with institutional guidelines.

Statistics

The values are shown as the mean ± SD. Two-group differences in the mean values were analyzed using an unpaired *t*-test and multiple-group differences were analyzed using one-way analysis of variance (ANOVA). Tukey multiple comparisons test was used when the ANOVA yielded a P value of < 0.1. Generally, a P value of < 0.05 was considered statistically significant. When the P values were < 0.1 in the *t*-test or Tukey-test, the effect size (Cohen's d) was calculated. The value of Cohen's d reflects the impact of each causal variable: values between 0.2 and < 0.5 denote a small but clinically meaningful difference between the groups; values between 0.5 and < 0.8 denote a medium effect; and values ≥ 0.8 indicate a large effect. All statistical analyses were performed using JMP12.0.1 software (SAS Institute Inc., Cary, NC, United States).

Table 1 Structure of postgastrectomy syndrome assessment scale 45 (domains/subdomains/items/subscales)

Domains	Subdomains	Items	Subscales
QOL	SF-8 (QOL)	1 Physical functioning*	Physical component summary* (items 1-8)
		2 Role physical*	
		3 Bodily pain*	Mental component summary* (items 1-8)
		4 General health*	
		5 Vitality*	
		6 Social functioning*	
		7 Role emotional*	
		8 Mental health*	
Symptoms	GSRS (symptoms)	9 Abdominal pains	Esophageal reflux subscale (items 10, 11, 13, 24)
		10 Heartburn	
		11 Acid regurgitation	
		12 Sucking sensations in the epigastrium	Abdominal pain subscale (items 9, 12, 28)
		13 Nausea and vomiting	
		14 Borborygmus	Meal-related distress subscale (items 25-27)
		15 Abdominal distension	
		16 Eructation	Indigestion subscale (items 14-17)
		17 Increased flatus	Diarrhea subscale (items 19, 20, 22)
		18 Decreased passage of stool	
		19 Increased passage of stool	Constipation subscale (items 18, 21, 23)
		20 Loose stool	
		21 Hard stool	Dumping subscale (items 30, 31, 33)
		22 Urgent need for defecation	
		23 Feeling of incomplete evacuation	Total symptom score (above seven subscales)
	Symptoms	24 Bile regurgitation	
		25 Sense of food sticking	
		26 Postprandial fullness	
		27 Early satiation	
		28 Lower abdominal pain	
		29 Number and type of early dumping symptoms	
		30 Early dumping general symptoms	
		31 Early dumping abdominal symptoms	
		32 Number and type of late dumping symptoms	
		33 Late dumping symptoms	
Living status	Meals (amount) 1	34 Ingested amount of food per meal*	Quality of ingestion subscale* (items 38-40)
		35 Ingested amount of food per day*	
		36 Frequency of main meals	
		37 Frequency of additional meals	
	Meals (quality)	38 Appetite*	

		39 Hunger feeling*	
		40 Satiety feeling*	
	Meals (amount) 2	41 Necessity for additional meals	
	Social activity	42 Ability to work	
QOL	Dissatisfaction (QOL)	43 Dissatisfaction with symptoms	Dissatisfaction for daily life subscale (items 43-45)
		44 Dissatisfaction at the meals	
		45 Dissatisfaction at working	

In items or subscales with *; higher score indicating better condition. In items or subscales without *; higher score indicating worse condition. Each subscale is calculated as the mean of composed items or subscales except PCS and MCS of SF-8. Item 29 and 32 don't have score. Then, they were analyzed separately. Citation: Nakada K, Ikeda M, Takahashi M, Kinami S, Yoshida M, Uenosono Y, Kawashima Y, Oshio A, Suzukamo Y, Terashima M, Kodera Y. Characteristics and clinical relevance of postgastrectomy syndrome assessment scale (PGSAS)-45: newly developed integrated questionnaires for assessment of living status and quality of life in postgastrectomy patients. *Gastric Cancer* 2015; 18: 147-158. QOL: Quality of life.

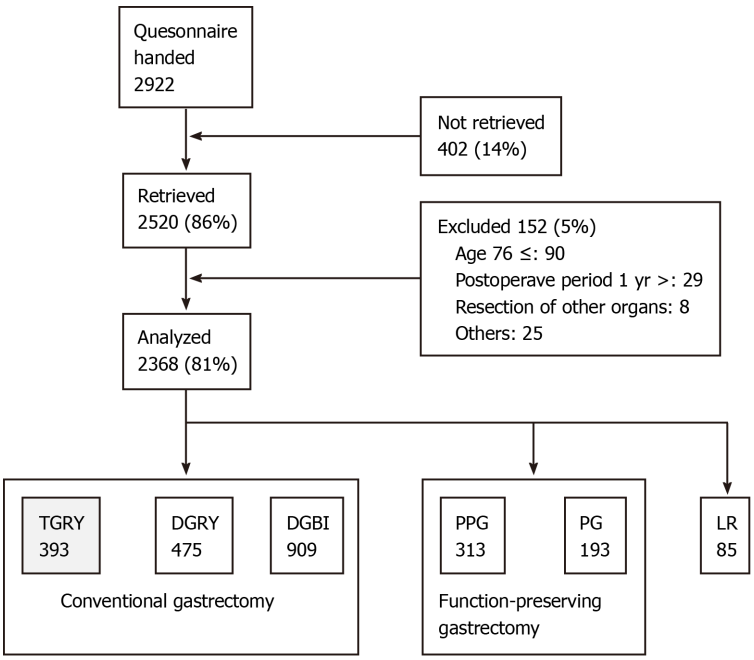

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Figure 1 Outline of the study. TGRY: Total gastrectomy with Roux-en-Y reconstruction; DGRY: Distal gastrectomy with Roux-en-Y reconstruction; DGBI: Distal gastrectomy with Billroth I reconstruction; PPG: Pylorus-preserving gastrectomy; PG: Proximal gastrectomy; LR: Local resection.

RESULTS

Patient characteristics

Characteristics of the 393 patients are listed in Table 2. The mean age was 63.4 years and the mean postoperative follow-up period was approximately 35 mo. It was observed that the number of male patients was more than the number of female patients and open surgery was more commonly used than laparoscopic surgery. The combined resection of another organ was performed for the gall bladder (83 patients) and spleen (52 patients). Dissection of the lymph node was over D1b in most of the patients. Conversely, celiac branch of the vagus nerve was not preserved in most patients.

Route of the Roux limb

The jejunum elevation route during Roux-en-Y reconstruction was described for 385 (98.0%) patients (Table 3). Retrocolic elevation (206 patients) was performed more commonly than antecolic elevation (179 patients). Among the 19 main outcome measures, scores for the esophageal reflux SS were significantly superior in antecolic elevation group compared to retrocolic elevation group with small but clinically meaningful effect (P = 0.028, Cohen's = 0.23).

Table 2 Patients' characteristics (393 cases are listed)

Characteristics	Values
Number of patients	393
Postoperative period (mo), mean ± SD	35.0 ± 24.6
Preoperative BMI, mean ± SD	23.0 ± 3.3
Postoperative BMI, mean ± SD	19.8 ± 2.5
Age, mean ± SD	63.4 ± 9.2
Gender (male/female)	276/113
Approach (laparoscopic/open)	97/293
Extent of lymph node dissection[1]	
D2	164
D1b	192
D1a	28
D1	4
D1>	0
None	0
Celiac branch of the vagal nerve (preserved/divided)	12/371
Combined resection	
Gallbladder	83
Spleen	52
Miscellaneous	2
None	246

[1]According to the Japanese gastric cancer treatment guideline. BMI: Body mass index.

Length of the Roux limb

Of the 393 patients, the length of the Roux limb was described in 373 (94.9%) patients (Table 4). The most common Roux limb length was "40 cm" (238 patients), followed by "longer (≥ 41 cm)" (119 patients) and "shorter (≤ 39 cm)" (16 patients) Roux limb length (Figure 3). "Shorter" Roux limb length had not worsen the esophageal reflux SS, and rather reduced the indigestion SS compared to both the "40 cm" and "longer" Roux limb groups with medium effect size in terms of Cohen's *d* values (shorter *vs* 40 cm: $P = 0.020$, Cohen's $d = 0.69$; "shorter" *vs* "longer": $P = 0.030$, Cohen's $d = 0.68$, respectively). In addition, "shorter" Roux limb attenuated abdominal pain SS with marginal significance ($P = 0.081$).

Anastomotic procedure for esophagojejunostomy

Of the 393 patients, the device used for anastomosis between the esophagus and jejunum was described in 388 (98.7%) patients (Table 5). The CS was used in 348 patients, while the LS was used in 40 patients. Among the 19 main outcome measures of PGSAS-45, there was no difference between the two procedures.

DISCUSSION

Postgastrectomy syndrome is the severest following total gastrectomy and persists in the long-term; thereby, lowering patients' QOL[1,2,4,5]. Therefore improvement of surgical techniques to reduce the onset of this syndrome is important. TGRY is a simple and robust technique that is performed widely and regarded as the gold standard for post-total gastrectomy reconstruction. While the increased use of laparoscopic surgery and anastomotic devices has resulted in the diversification of TGRY surgical techniques[6-12], the effects of different TGRY techniques on patients' QOL remains unknown. Our results indicate that elevation of the Roux limb *via* antecolic route resulted in fewer esophageal reflux SS, and the relatively "shorter" Roux limb length accompanied by fewer indigestion SS without increasing esophageal reflux SS. In terms of device selection for esophagojejunostomy, no difference was

Table 3 The effect of the reconstruction route (antecolic or retrocolic) of Roux–limb on postoperative quality of life after total gastrectomy

Reconstruction route of Roux limb	Retro-colica (*n* = 206)		Ante-colica (*n* = 179)		*P* value	Cohens *d*
	mean	SD	mean	SD		
Esophageal reflux SS	2.1	1.1	1.8	0.9	0.028	0.229
Abdominal pain SS	1.8	0.8	1.7	0.8	NS	
Meal-related distress SS	2.7	1.1	2.6	1.1	NS	
Indigestion SS	2.3	0.98	2.3	0.9	NS	
Diarrhea SS	2.4	1.3	2.2	1.1	NS	
Constipation SS	2.1	1.0	2.0	0.8	NS	
Dumping SS	2.4	1.1	2.3	1.1	NS	
Total symptom score	2.2	0.8	2.1	0.7	NS	
Change in Body weight	-13.6%	7.8%	-14.0%	8.1%	NS	
Ingested amount of food per meal	6.5	1.9	6.4	1.8	NS	
Necessity for additional meals	2.3	0.8	2.4	0.7	NS	
Quality of ingestion SS	3.7	1.0	3.8	0.9	NS	
Ability to work	2.1	0.9	2.0	0.8	NS	
Dissatisfaction with symptoms	2.1	1.0	2.0	1.0	NS	
Dissatisfaction at the meal	2.8	1.1	2.8	1.1	NS	
Dissatisfaction at working	2.1	1.1	2.2	1.0	NS	
Dissatisfaction for daily life SS	2.4	0.9	2.3	0.9	NS	
Physical component summary	49.2	5.8	50.1	5.4	NS	
Mental component summary	49.1	6.1	49.2	5.9	NS	

SS: Subscale; NS: Not significant.

Table 4 The effect of the length of Roux-limb (shorter, 40 cm, longer) on postoperative quality of life after total gastrectomy

Length of Roux limb	Shorter (*n* = 16)		40 cm (*n* = 238)		Longer (*n* = 119)		ANOVA	Multiple comparisons	*P* value	Cohens *d*
	mean	SD	mean	SD	mean	SD	*P* value			
Esophageal reflux SS	1.8	0.9	2.0	1.1	2.0	1.0	NS			
Abdominal pain SS	1.4	0.4	1.8	0.8	1.7	0.7	0.081	Shorter *vs* 40 cm	0.053	0.52
Meal-related distress SS	2.2	0.9	2.7	1.2	2.7	1.0	NS			
Indigestion SS	1.7	0.7	2.3	0.9	2.3	0.9	0.026	Shorter *vs* 40 cm	0.020	0.69
								Shorter *vs* longer	0.030	0.68
Diarrhea SS	2.0	1.2	2.3	1.2	2.3	1.2	NS			
Constipation SS	2.3	0.9	2.1	0.9	2.1	0.9	NS			
Dumping SS	1.8	0.9	2.4	1.1	2.3	1.1	NS			
Total symptom score	1.9	0.6	2.2	0.8	2.2	0.7	NS			
Change in Body weight	-14.1%	8.6%	-13.8%	8.2%	-13.5%	7.5%	NS			
Ingested amount of food per meal	5.5	2.6	6.4	1.9	6.5	1.7	NS			
Necessity for additional meals	2.4	0.8	2.4	0.8	2.3	0.7	NS			
Quality of ingestion SS	3.3	1.2	3.8	0.9	3.8	1.0	NS			
Ability to work	2.4	1.2	2.0	0.9	2.1	0.9	NS			

Dissatisfaction with symptoms	1.8	1.0	2.0	1.1	2.2	1.0	NS
Dissatisfaction at the meal	3.3	1.2	2.8	1.2	2.8	1.0	NS
Dissatisfaction at working	2.5	1.3	2.2	1.1	2.1	1.0	NS
Dissatisfaction for daily life SS	2.5	1.0	2.3	0.9	2.4	0.8	NS
Physical component summary	49.2	6.7	49.4	5.7	50.1	5.5	NS
Mental component summary	48.1	5.9	48.7	6.3	49.9	5.5	NS

SS: Subscale; NS: Not significant.

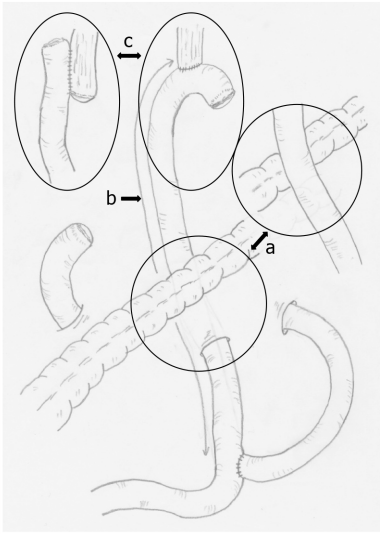

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Figure 2 Schema of Roux-en-Y reconstruction after total gastrectomy. a: Route of the Roux limb (antecolic or retrocolic); b: Length of the Roux limb defined as the distance from the esophago-jejunostomy to the jejunojejunostomy [shorter (≤ 39 cm), average (40 cm) or longer (≥ 41 cm)]; c: Anastomotic procedure for esophagojejunostomy (reconstruction using a circular or linear stapler).

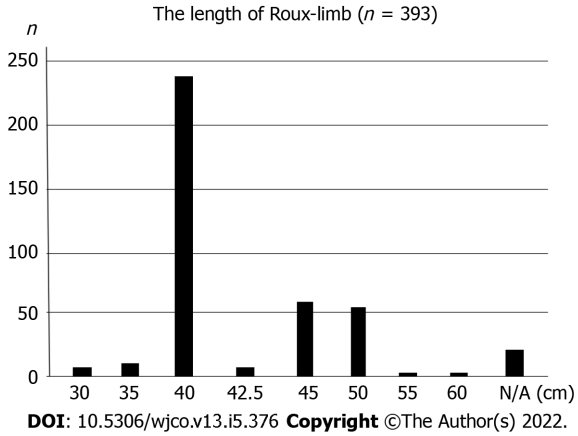

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Figure 3 The distribution of the length of Roux-limb after total gastrectomy. N/A: Not answered group indicated.

observed between the CS and LS procedures. To the best of our knowledge, this is the first report to demonstrate that differences in surgical techniques in TGRY affect postoperative QOL.

The Roux limb reconstruction in TGRY has often been performed *via* retrocolic route in open surgeries, as it applies slight tension to the anastomosis due to the short distance to the esophageal stump. With the increased use of laparoscopic surgery, surgeons began elevating the Roux limb *via* antecolic route due to its technical simplicity[7]. And then, the antecolic elevation became more common even for open total gastrectomy. Our investigation into the effects of different Roux limb reconstruction routes in TGRY on postoperative QOL indicate that esophageal reflux SS was significantly attenuated in

Table 5 The effect of anastomotic procedure for esophagojejunostomy (circular stapler, linear stapler) on postoperative quality of life after total gastrectomy

Anastomotic method	Circular stapler(*n* = 348)		Liner stapler (*n* = 40)		*P* value
	mean	SD	mean	SD	
Esophageal reflux SS	2.0	1.0	1.9	0.8	NS
Abdominal pain SS	1.8	0.8	1.7	0.8	NS
Meal-related distress SS	2.6	1.1	2.8	1.2	NS
Indigestion SS	2.3	0.9	2.2	0.8	NS
Diarrhea SS	2.3	1.2	2.2	1.3	NS
Constipation SS	2.1	0.9	2.1	1.0	NS
Dumping SS	2.3	1.1	2.4	1.1	NS
Total symptom score	2.2	0.7	2.1	0.7	NS
Change in Body weight	-13.9%	7.9%	-12.8%	7.9%	NS
Ingested amount of food per meal	6.5	1.9	6.2	1.8	NS
Necessity for additional meals	2.3	0.8	2.4	0.8	NS
Quality of ingestion SS	3.8	1.0	3.8	0.9	NS
Ability to work	2.0	0.9	2.1	0.9	NS
Dissatisfaction with symptoms	2.1	1.0	2.1	0.9	NS
Dissatisfaction at the meal	2.8	1.1	3.0	1.0	NS
Dissatisfaction at working	2.1	1.1	2.2	1.0	NS
Dissatisfaction for daily life SS	2.3	0.9	2.5	0.8	NS
Physical component summary	49.6	5.7	50.2	4.9	NS
Mental component summary	49.2	6.0	49.2	5.9	NS

SS: Subscale; NS: Not significant.

the antecolic route group than the retrocolic route group. One of the possible explanation is that in the antecolic reconstruction, duodenal fluid hardly flow back into the esophagus unless it passes over the height of the transverse colon when the patient took the lying-down position. As a result, this physical barrier of gravity could attenuate the esophageal reflux SS in addition to the preventive effect of the peristalsis of the Roux limb. Based on these, the antecolic route may be a suitable surgical procedure when performing TGRY. Although the caution is needed for the occurrence of the internal hernia through Petersen's defect especially when the gastrectomy underwent laparoscopically, and the implementing preventive methods such as the closure of these defects with sutures[20,21] should be performed.

Many surgeons concern that the insufficient length of Roux limb likely to increase the esophageal regurgitation. However, in the present study, the esophageal reflux SS did not worsened in the "shorter" Roux limb length group compared to the other groups, therefore, even relatively short Roux limbs of 30-35 cm may have produced the sufficient intestinal peristalsis to prevent esophageal regurgitation. Interestingly, significantly more indigestion SS was observed in the "40 cm" and "longer" Roux limb length groups compared to the "shorter" group. This may be, in part, explained by the previous report[22] showing that relatively long Roux limbs could be a cause of Roux-en-Y syndrome. The Roux limb length should be adjusted as an appropriate length, and not too long[22].

Although esophagojejunostomy in TGRY had mainly performed using the CS, the increase in laparoscopic surgery has resulted in the diversification of anastomotic techniques and the esophagojejunostomy using the LS is increasing[9-11]. Comparison of the CS and LS procedures in terms of the effect of the esophagojejunostomy technique on postoperative QOL revealed no differences in any of the main outcome measures of PGSAS-45, therefore, either of the CS or LS procedures can be selected depending on the clinical situation to achieve a safe and simple anastomosis procedure.

Many surgeons had chosen the retrocolic route as that of the Roux limb from the problems concerned with the distance of Roux limb and occurrence of internal hernia, and enough length of the Roux limb preventing the regurgitation to esophagus. The result of this PGSAS study may provide a hint for the optimal surgical procedures after total gastrectomy. A limitation of the present study is its retrospective

nature and the unbalanced number of patients in each group. A well-designed prospective study should be conducted in the future.

CONCLUSION

Our results revealed that the specific surgical technique used for TGRY affects postoperative QOL to some extent. Since postgastrectomy syndrome is the severest following total gastrectomy, a technique that could maintain a favorable postoperative QOL should be selected. The findings of this study suggest that some of the postgastrectomy symptoms following TGRY could be attenuated by elevating Roux limb through antecolic route with not too long Roux limb length.

ARTICLE HIGHLIGHTS

Research background

Following a total gastrectomy using various techniques, some patients suffer the severe form of postgastrectomy syndrome.

Research motivation

Although the differences in techniques of Roux-en-Y reconstruction appear to affect postoperative quality of life (QOL), the reasons remain unclear due to lack of sufficient investigation.

Research objectives

We investigated the effect of different techniques on postoperative QOL.

Research methods

Using the Postgastrectomy Syndrome Assessment Scale-45, we investigated the effect of different techniques in Roux-en-Y reconstruction on postoperative QOL. We analyzed 393 total gastrectomy patients.

Research results

Esophageal reflux subscale (SS) occurred significantly less frequently in patients who underwent antecolic reconstruction. Shorter Roux limb did not facilitate esophageal reflux SS and somewhat attenuated indigestion SS and abdominal pain SS.

Research conclusions

Our results suggest that elevating the Roux limb which is not overly long, through an antecolic route may attenuate some of the postgastrectomy symptoms.

Research perspectives

Patients' QOL after total gastrectomy may be improved by this study.

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FOOTNOTES

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REFERENCES

1 **Karanicolas PJ**, Graham D, Gönen M, Strong VE, Brennan MF, Coit DG. Quality of life after gastrectomy for adenocarcinoma: a prospective cohort study. *Ann Surg* 2013; **257**: 1039-1046 [PMID: 23665970 DOI: 10.1097/SLA.0b013e31828c4a19]

2 **Lee JH**, Lee HJ, Choi YS, Kim TH, Huh YJ, Suh YS, Kong SH, Yang HK. Postoperative Quality of Life after Total

Gastrectomy Compared with Partial Gastrectomy: Longitudinal Evaluation by European Organization for Research and Treatment of Cancer-OG25 and STO22. *J Gastric Cancer* 2016; **16**: 230-239 [PMID: 28053809 DOI: 10.5230/jgc.2016.16.4.230]

3 **Rausei S**, Mangano A, Galli F, Rovera F, Boni L, Dionigi G, Dionigi R. Quality of life after gastrectomy for cancer evaluated *via* the EORTC QLQ-C30 and QLQ-STO22 questionnaires: surgical considerations from the analysis of 103 patients. *Int J Surg* 2013; **11** Suppl 1: S104-S109 [PMID: 24380539 DOI: 10.1016/S1743-9191(13)60028-X]

4 **Takiguchi N**, Takahashi M, Ikeda M, Inagawa S, Ueda S, Nobuoka T, Ota M, Iwasaki Y, Uchida N, Kodera Y, Nakada K. Long-term quality-of-life comparison of total gastrectomy and proximal gastrectomy by postgastrectomy syndrome assessment scale (PGSAS-45): a nationwide multi-institutional study. *Gastric Cancer* 2015; **18**: 407-416 [PMID: 24801198 DOI: 10.1007/s10120-014-0377-8]

5 **Tanizawa Y**, Tanabe K, Kawahira H, Fujita J, Takiguchi N, Takahashi M, Ito Y, Mitsumori N, Namikawa T, Oshio A, Nakada K; Japan Postgastrectomy Syndrome Working Party. Specific Features of Dumping Syndrome after Various Types of Gastrectomy as Assessed by a Newly Developed Integrated Questionnaire, the PGSAS-45. *Dig Surg* 2016; **33**: 94-103 [PMID: 26682541 DOI: 10.1159/000442217]

6 **Hirahara N**, Monma H, Shimojo Y, Matsubara T, Hyakudomi R, Yano S, Tanaka T. Reconstruction of the esophagojejunostomy by double stapling method using EEA™ OrVil™ in laparoscopic total gastrectomy and proximal gastrectomy. *World J Surg Oncol* 2011; **9**: 55 [PMID: 21599911 DOI: 10.1186/1477-7819-9-55]

7 **Hosoya Y**, Lefor A, Ui T, Haruta H, Kurashina K, Saito S, Zuiki T, Sata N, Yasuda Y. Internal hernia after laparoscopic gastric resection with antecolic Roux-en-Y reconstruction for gastric cancer. *Surg Endosc* 2011; **25**: 3400-3404 [PMID: 21573714 DOI: 10.1007/s00464-011-1739-5]

8 **Zhao YL**, Su CY, Li TF, Qian F, Luo HX, Yu PW. Novel method for esophagojejunal anastomosis after laparoscopic total gastrectomy: semi-end-to-end anastomosis. *World J Gastroenterol* 2014; **20**: 13556-13562 [PMID: 25309086 DOI: 10.3748/wjg.v20.i37.13556]

9 **Kitagami H**, Morimoto M, Nakamura K, Watanabe T, Kurashima Y, Nonoyama K, Watanabe K, Fujihata S, Yasuda A, Yamamoto M, Shimizu Y, Tanaka M. Technique of Roux-en-Y reconstruction using overlap method after laparoscopic total gastrectomy for gastric cancer: 100 consecutively successful cases. *Surg Endosc* 2016; **30**: 4086-4091 [PMID: 26701704 DOI: 10.1007/s00464-015-4724-6]

10 **Huang ZN**, Huang CM, Zheng CH, Li P, Xie JW, Wang JB, Lin JX, Lu J, Chen QY, Cao LL, Lin M, Tu RH, Lin JL. Digestive tract reconstruction using isoperistaltic jejunum-later-cut overlap method after totally laparoscopic total gastrectomy for gastric cancer: Short-term outcomes and impact on quality of life. *World J Gastroenterol* 2017; **23**: 7129-7138 [PMID: 29093621 DOI: 10.3748/wjg.v23.i39.7129]

11 **Gong CS**, Kim BS, Kim HS. Comparison of totally laparoscopic total gastrectomy using an endoscopic linear stapler with laparoscopic-assisted total gastrectomy using a circular stapler in patients with gastric cancer: A single-center experience. *World J Gastroenterol* 2017; **23**: 8553-8561 [PMID: 29358863 DOI: 10.3748/wjg.v23.i48.8553]

12 **Norero E**, Muñoz R, Ceroni M, Manzor M, Crovari F, Gabrielli M. Two-Layer Hand-Sewn Esophagojejunostomy in Totally Laparoscopic Total Gastrectomy for Gastric Cancer. *J Gastric Cancer* 2017; **17**: 267-276 [PMID: 28970957 DOI: 10.5230/jgc.2017.17.e26]

13 **Nakada K**, Ikeda M, Takahashi M, Kinami S, Yoshida M, Uenosono Y, Kawashima Y, Oshio A, Suzukamo Y, Terashima M, Kodera Y. Characteristics and clinical relevance of postgastrectomy syndrome assessment scale (PGSAS)-45: newly developed integrated questionnaires for assessment of living status and quality of life in postgastrectomy patients. *Gastric Cancer* 2015; **18**: 147-158 [PMID: 24515247 DOI: 10.1007/s10120-014-0344-4]

14 **Japanese Gastric Cancer Association**. Japanese gastric cancer treatment guidelines 2010 (ver. 3). *Gastric Cancer* 2011; **14**: 113-123 [PMID: 21573742 DOI: 10.1007/s10120-011-0042-4]

15 **Aaronson NK**, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, Filiberti A, Flechtner H, Fleishman SB, de Haes JC, Kaasa S, Klee M, Osoba D, Razavi D, Rofe PB, Schraub S, Sneeuw K, Sullivan M, Takeda F. The European Organization for Research and Treatment of Cancer QLQ-C30: a quality-of-life instrument for use in international clinical trials in oncology. *J Natl Cancer Inst* 1993; **85**: 365-376 [PMID: 8433390 DOI: 10.1093/jnci/85.5.365]

16 **Sprangers MA**, Cull A, Groenvold M, Bjordal K, Blazeby J, Aaronson NK. The European Organization for Research and Treatment of Cancer approach to developing questionnaire modules: an update and overview. EORTC Quality of Life Study Group. *Qual Life Res* 1998; **7**: 291-300 [PMID: 9610213 DOI: 10.1023/a:1024977728719]

17 **Kaasa S**, Bjordal K, Aaronson NK, Moum T, Wist E, Hagen S, Kvikstad A. The EORTC core quality of life questionnaire (QLQ-C30): validity and reliability when analysed with patients treated with palliative radiotherapy. *Eur J Cancer* 1995; **31A**: 2260-2263 [PMID: 8652253 DOI: 10.1016/0959-8049(95)00296-0]

18 **Turner-Bowker DM**, Bayliss MS, Ware JE Jr, Kosinski M. Usefulness of the SF-8 Health Survey for comparing the impact of migraine and other conditions. *Qual Life Res* 2003; **12**: 1003-1012 [PMID: 14651418 DOI: 10.1023/a:1026179517081]

19 **Svedlund J**, Sjödin I, Dotevall G. GSRS--a clinical rating scale for gastrointestinal symptoms in patients with irritable bowel syndrome and peptic ulcer disease. *Dig Dis Sci* 1988; **33**: 129-134 [PMID: 3123181 DOI: 10.1007/BF01535722]

20 **Kimura H**, Ishikawa M, Nabae T, Matsunaga T, Murakami S, Kawamoto M, Kamimura T, Uchiyama A. Internal hernia after laparoscopic gastrectomy with Roux-en-Y reconstruction for gastric cancer. *Asian J Surg* 2017; **40**: 203-209 [PMID: 26589299 DOI: 10.1016/j.asjsur.2015.09.003]

21 **Ojima T**, Nakamori M, Nakamura M, Katsuda M, Hayata K, Kato T, Tsuji T, Yamaue H. Internal Hernia After Laparoscopic Total Gastrectomy for Gastric Cancer. *Surg Laparosc Endosc Percutan Tech* 2017; **27**: 470-473 [PMID: 28945693 DOI: 10.1097/SLE.0000000000000481]

22 **Gustavsson S**, Ilstrup DM, Morrison P, Kelly KA. Roux-Y stasis syndrome after gastrectomy. *Am J Surg* 1988; **155**: 490-494 [PMID: 3344916 DOI: 10.1016/s0002-9610(88)80120-x]

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