


ORIGINAL ARTICLE

Evaluation of postgastrectomy symptoms and daily lives of small remnant distal gastrectomy for upper-third gastric cancer using a large-scale questionnaire survey

Souya Nunobe¹  | Masazumi Takahashi² | Shinichi Kinami³ | Junya Fujita⁴ | Takahisa Suzuki⁵ | Akihiro Suzuki⁶ | Toshiyuki Tanahashi⁷ | Yoshihiko Kawaguchi⁸ | Atsushi Oshio⁹ | Koji Nakada¹⁰

¹Department of Gastroenterological surgery, Cancer Institute Ariake Hospital, Koto-ku, Japan

²Division of Gastroenterological Surgery, Yokohama Municipal Cirizen's Hospital, Kanagawa, Japan

³Department of Surgical Oncology, Kanazawa Medical University, Kahoku-gun, Japan

⁴Department of surgery, Yao Municipal Hospital, Osaka, Japan

⁵Department of Surgery, National Hospital Organization, Kure Medical Center, Chu-goku Cancer Center, Hiroshima, Japan

⁶Department of Gastrointestinal Surgery, St. Luke's International Hospital, Chuo-ku, Japan

⁷Department of Surgery, Gifu Municipal Hospital, Gifu, Japan

⁸First Department of Surgery, Faculty of Medicine, University of Yamanashi, Chuo, Japan

⁹Faculty of Letters, Arts and Sciences, Waseda University, Shinjuku-ku, Japan

¹⁰Department of Laboratory Medicine, The Jikei University School of Medicine, Tokyo, Japan

Correspondence

Souya Nunobe, Department of Gastroenterological Surgery, Cancer Institute Ariake Hospital, 8-31, Ariake 3-chome, Koto-ku, Tokyo 135-8550, Japan.
Email: souya.nunobe@jfc.or.jp

Funding information

Jikei University and the Japanese Gastric Cancer Association

Abstract

Aim: Total gastrectomy (TG) is often performed for proximal gastric cancer. Small remnant distal gastrectomy (SRDG) can also be used in cases where surgical margins can be secured. The impact of preserving proximal small remnant stomach on postoperative quality of life (QOL) has not been fully elucidated. In the present study, we compared postgastrectomy symptoms and daily lives between patients undergoing SRDG and those undergoing TG for proximal gastric cancer using the developed Postgastrectomy Syndrome Assessment Scale (PGSAS)-45.

Methods: Of the 1909 patients enrolled in the PGSAS NEXT study, univariate analysis of 19 main outcomes measures (MOMs) of PGSAS-45 was performed in patients undergoing TG (n = 1020) or SRDG (n = 54). Multiple regression analysis was performed with several clinical factors as explanatory variables.

Results: There was no difference in age and sex between TG and SRDG groups. In SRDG group, postoperative period was shorter, the rates of laparoscopic approach and preservation of the celiac branch of the vagus nerve were higher, and the rates of clinical stage III/IV disease, \geq D2 dissection, and combined resection with other organs were lower than in the TG group significantly ($P < .05$). SRDG was associated with

This is an open access article under the terms of the [Creative Commons Attribution-NonCommercial-NoDerivs](https://creativecommons.org/licenses/by-nc-nd/4.0/) License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.

© 2021 The Authors. *Annals of Gastroenterological Surgery* published by John Wiley & Sons Australia, Ltd on behalf of The Japanese Society of Gastroenterology.

significantly lower symptoms and better daily lives than TG in 12 and 13 of 19 MOMs in PGSAS-45 by univariate and multiple regression analyses, respectively ($P < .05$). Several other clinical factors were also associated with certain MOMs.

Conclusion: The PGSAS-45 revealed that SRDG was associated with better postgastroectomy symptoms and daily lives than TG.

KEYWORDS

patient-reported outcomes, postgastroectomy symptoms, proximal gastric cancer, small remnant distal gastrectomy, total gastrectomy

1 | INTRODUCTION

Gastric cancer, which is a common cancer and the second most common cause of cancer-related deaths globally, is also the most prevalent cancer in Japan and East Asia.¹ The treatment of gastric cancer with curative intent requires gastrectomy with adequate lymph node dissection. The 5-year survival rate of early-stage gastric cancer is over 90%, and postoperative quality of life (QOL) remains an important issue in these patients.²

The incidence of gastric cancer in the upper-third of the stomach has been increasing in Asia in recent years.³⁻⁵ Although total gastrectomy (TG) is often indicated in early-stage proximal gastric cancer, this approach is a technical hindrance to esophageal-jejunal reconstruction and postoperative maintenance of nutritional status is more difficult due to the loss of storage capacity.⁶ Considering these issues, small remnant distal gastrectomy (SRDG) has been also performed in patients with upper-third early-stage cancer, with several studies demonstrating its surgical and nutritional benefits compared to TG.^{7,8} Although one study compared conventional distal gastrectomy with TG,⁹ optimal approaches to evaluate patient burdens following SRDG and TG have not yet been established.

The Japan Postgastroectomy Syndrome Working Party was founded to investigate symptoms and lifestyle changes in patients undergoing gastrectomy. The group collaboratively developed the Postgastroectomy Syndrome Assessment Scale-45 (PGSAS-45), a questionnaire which evaluates the general features, including symptoms, living status, and QOL, of patients in the postoperative gastrectomy period. The questionnaire has been used for the PGSAS study, a nationwide, multi-institutional surveillance study.¹⁰ After that, a nationwide multi-institutional cross-sectional study using PGSAS-45, the PGSAS NEXT study, was conducted to explore the optimal gastrectomy procedure for the cancer located at the upper third of the stomach or at around the esophagogastric junction. As a part of the PGSAS NEXT study, we aimed to determine the impact of preserving small remnant stomach and esophagogastric junction on postoperative QOL. We therefore compared postgastroectomy symptoms and daily lives after SRDG or TG in patients with upper-third gastric cancer using the PGSAS-45.

2 | PATIENTS AND METHODS

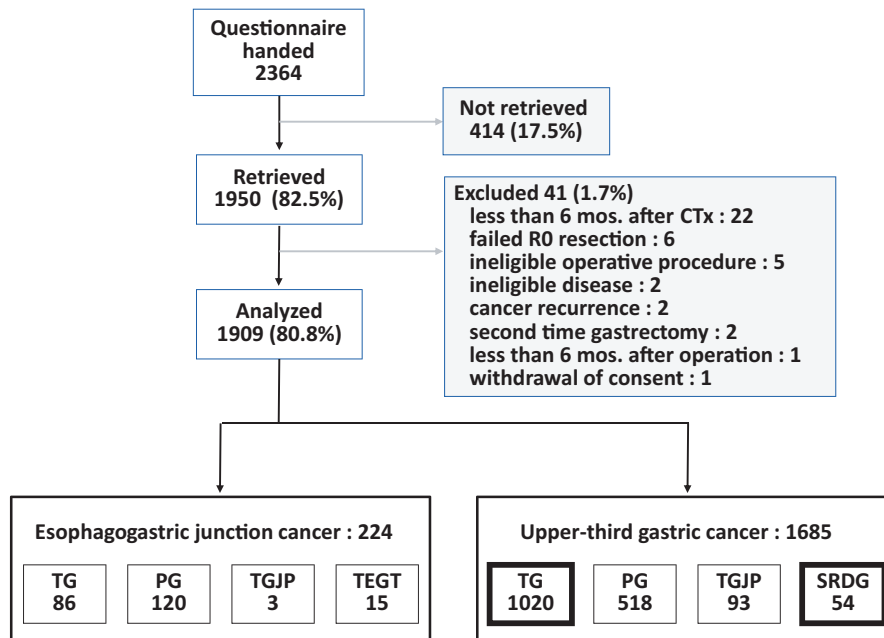
2.1 | Patients

This cross-sectional study included 70 participating institutions. The PGSAS-45 was distributed to 2364 patients between July 2018 and December 2019. Among a total of 1950 (82.5%) completed questionnaires retrieved from the patients, 41 (1.7%) were deemed ineligible due to chemotherapy treatment within the preceding 6 months, failed R0 resection, ineligible operative procedure, ineligible disease, cancer recurrence, second gastrectomy, postoperative period of shorter than 6 months, and consent withdrawal in 22, 6, 5, 2, 2, 2, 1, and 1 patient, respectively. Among the remaining 1909 questionnaires (80.8%), 1685 patients were diagnosed with gastric cancer affecting the upper-third of the stomach. Of these, 1020 patients who underwent conventional TG and 54 patients who underwent SRDG, where the remnant proximal stomach size was equal to or less than one fifth, were included in the present study (Figure 1). Reconstruction procedures were not regulated by study-specific protocols and were chosen based on the principles or discretion of the treating surgeon or institution.

2.2 | Patient eligibility criteria

The patient inclusion criteria were (1) female or male aged 20 years or older; (2) cancer located in the upper-third of the stomach or around the esophagogastric junction (any stage or histologic type); (3) successful R0 resection; (4) no recurrence or metastasis; (5) postoperative period of more than 6 months; (6) previous chemotherapy allowed in cases with more than 6 months since treatment termination; (7) only one gastrectomy; (8) Eastern Cooperative Oncology Group Scale performance status of 0 or 1; (9) capability of understanding the questionnaire; (10) absence of other diseases or previous surgeries that could mask the effect of gastrectomy results in the questionnaire; (11) no organ failure or mental disease; (12) and willingness to participate in the study. The exclusion criteria were (1) active dual malignancy and (2) synchronous another surgery with exception of the resection or the extraction of the perigastric organs to accomplish gastrectomy or lymph node dissection, and ones equivalent to cholecystectomy.

FIGURE 1 Outline of the study. CTx, Chemotherapy; PG, Proximal gastrectomy; SRDG, Small remnant distal gastrectomy; TEGT, Thoracic esophagectomy with gastric-tube reconstruction; TG, Total gastrectomy; TGJP, Total gastrectomy with jejunal pouch reconstruction



2.3 | QOL assessment

In the present study, PGSAS-45, a multidimensional QOL questionnaire based on the 8-Item Short Form Health Survey (SF-8) and Gastrointestinal Symptoms Rating Scale (GSRS), was used to assess post-gastrectomy symptoms and daily lives.¹⁰⁻¹² The questionnaire comprises 45 questions, with 8 and 15 items from the SF-8 and GSRS, respectively, and 22 clinically important items selected by the Japan Postgastrectomy Syndrome Working Party (Table 1). Specifically, the PGSAS-45 comprises 23 items pertaining to postoperative symptoms (items 9-33, except for items 29 and 32), including 15 items from the GSRS and 8 newly selected items. In addition, 12 items are related to dietary intake, work, and level of satisfaction with daily life. Five dietary intake items are related to the amount of food ingested (items 34-37 and 41), and three dietary intake items are related to the quality of ingestion (items 38-40). One questionnaire item pertains to work (item 42), whereas three items address the level of satisfaction with daily life (items 43-45). A seven-grade Likert scale is used for 23 symptom-related items, whereas a five-grade Likert scale is used for all other items, except for items 1, 4, 29, 32, and 34-37. For items 1-8, 34, 35, and 38-40, higher scores indicate better outcomes. For items 9-28, 30, 31, 33, and 41-45, higher scores indicate worse outcomes. A total of 19 main outcome measures (MOMs) have been refined through consolidation and selection and classified into three domains: symptoms, living status, and QOL (Table 2). The details of PGSAS-45 have been reported previously.^{10,13-18}

2.4 | Study design

The present study utilized continuous sampling from a central registration system for participant enrollment. The questionnaire was distributed to all eligible patients, who were instructed to return the completed forms to the data center. All QOL data from the questionnaires were matched with individual patient data collected via case report forms. The

study was registered with the University Hospital Medical Information Network Clinical Trials Registry (registration number 000032221) and approved by the ethics committees of all participating institutions. Written informed consent was obtained from all enrolled patients.

2.5 | Statistical analysis

Patient characteristics and MOMs were compared using Student's *t* or Fisher's exact test, as appropriate. All outcome measures were further analyzed using multiple regression analysis (MRA). Ten factors, including type of gastrectomy, age, sex, postoperative period, operative approach, preservation of the celiac branch of the vagus nerve, chemotherapy, clinical stage, extent of lymph node dissection, and combined resection with other organs, were included as explanatory variables in MRA. These factors were selected according to their clinical importance and based on the results of previous PGSAS studies. Statistical significance was set at a *P* value of <.05. For factors with a *P* < .1 in univariate analyses, Cohen's *d* was calculated. In MRA with a *P* < .1, the standardization coefficient of regression (β) and the *p* value were shown in a table. Cohen's *d*, β , and R^2 were used to measure effect sizes. Interpretation of effect sizes were as follows: small, Cohen's $d > 0.2$, $\beta > 0.1$, $R^2 > 0.02$; medium, Cohen's $d > 0.5$, $\beta > 0.3$, $R^2 > 0.13$; large, Cohen's $d > 0.8$, $\beta > 0.5$, $R^2 > 0.26$. All statistical analyses were performed using JMP 12.0.1 software (SAS Institute, Cary, NC, USA).

3 | RESULTS

3.1 | Patient characteristics

The characteristics of the study participants are summarized in Table 3. TG and SRDG were performed in 1020 and 54 patients, respectively. Compared with the TG group, the SRDG group had

TABLE 1 Structure of PGSAS-45

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

TABLE 1 (Continued)

Domains	Items		Subscales (SS)
Meals (quality)	38	Appetite*	Five-point Likert scale
	39	Hunger feeling*	
	40	Satiety feeling*	
Meals (amount) 2	41	Necessity for additional meals	-
Work	42	Ability for working	-
Dissatisfaction	43	Dissatisfaction with symptoms	Dissatisfaction for daily life SS (item 43-45)
	44	Dissatisfaction at the meal	
	45	Dissatisfaction at working	

Note: In items or subscales with*; higher score indicating better condition. In items or subscales without*; higher score indicating worse.

TABLE 2 Main outcomes measures in PGSAS

Domains		Main outcomes measures
Symptoms	Subscales	Seven symptom subscales Esophageal reflux (10, 11, 13, 24), Abdominal pain (9, 12, 28), Meal-related distress (25-27), Indigestion (14-17), Diarrhea (19, 20, 22), Constipation (18, 21, 23), Dumping (30, 31, 33) Total symptom score
	Total	
Living status	Body weight	Change in body weight (%)*
	Meals (amount)	Ingested amount of food per meal* (34)
	Meals (quality)	Necessity for additional meals (41)
	Work	Quality of ingestion subscale* (38-40) Ability for working (42)
QOL	Dissatisfaction	Dissatisfaction with symptoms (43), at the meal (44), at working (45) Dissatisfaction for daily life subscale (43-45) Physical component summary* (1-8) Mental component summary* (1-8)
	SF-8	

Note: "In items or subscales with*; higher score indicating better condition. In items or subscales without*; higher score indicating worse."

significantly higher postoperative body mass index (SRDG vs. TG; 20.4 ± 2.8 vs 19.7 ± 2.5 kg/m², $P = .042$), significantly shorter postoperative period (38.8 ± 23.6 vs 52.9 ± 36.5 months, $P = .005$), and significantly higher rates of laparoscopic utilization (85.2% vs 40.1%, $P < .001$) and preservation of the celiac branch of the vagus nerve (7.7% [4/52] vs 1.9% [19/993], $P = .024$; 2 and 27 cases missing in the SRDG and TG groups, respectively). Additionally, the SRDG group had significantly lower rates of advanced clinical stage ($P < .001$), adjuvant chemotherapy ($P = .007$), extended lymph node dissection ($P = .019$), and combined resection ($P < .001$) and a significantly higher rate of U area in tumor location than the TG group ($P < .001$).

3.2 | QOL assessment

The results of the MOMs following TG and SRDG are presented in Table 4. Compared with the TG group, the SRDG group showed significantly lower scores (indicating better condition) in esophageal reflux subscale (SRDG vs TG; 1.5 vs 2.1, $P < .001$, Cohen's $d = 0.55$), meal-related distress subscale (2.1 vs 2.6, $P < .001$, Cohen's $d = 0.46$), total symptom score (2.0 vs 2.2, $P = .031$, Cohen's $d = 0.32$), ability for working (1.8 vs 2.2, $P = .004$, Cohen's $d = 0.41$), dissatisfaction with symptoms (1.7 vs 2.0, $P = .015$, Cohen's $d = 0.34$), dissatisfaction at the meal (2.1 vs 2.7, $P = .001$, Cohen's $d = 0.49$), dissatisfaction at working (1.6 vs 2.1, $P < .001$, Cohen's $d = 0.50$), and dissatisfaction for daily life subscale (1.8 vs 2.3, $P < .001$, Cohen's $d = 0.52$) than the TG group. Additionally, compared with the TG group, the SRDG group had significantly higher scores (indicating better condition) in change in body weight (SRDG vs TG; -10.9% vs -14.3% , $P = .007$, Cohen's $d = 0.38$), ingested amount of food per meal (7.6 vs 6.1, $P < .001$, Cohen's $d = 0.78$), physical component summary of SF-8 (51.6 vs 48.7, $P < .001$, Cohen's $d = 0.50$), and mental component summary of SF-8 (51.1 vs 49.4, $P = .048$, Cohen's $d = 0.28$). Furthermore, the SRDG group exhibited better tendency in several MOMs, including abdominal pain subscale ($P = .084$, Cohen's $d = 0.24$), dumping subscale ($P = .061$, Cohen's $d = 0.28$), and necessity for additional meals ($P = .087$, Cohen's $d = 0.24$) than the TG group. Meanwhile, there were no significant adverse effects in any of the 19 MOMs in the SRDG group compared with the TG group.

MRA was performed to eliminate confounding factors such as age, sex (male or female), postoperative period, surgical approach (laparoscopic or open), intervention for the celiac branch of vagus nerve (preserved or divided), chemotherapy (yes or no), clinical stage (I/II or III/IV), lymph node dissection (D0/D1, D1+, or D2/D2+), and combined resection (yes, no) as explanatory variables (Table 5). Although the effect sizes of the advantages in the SRDG group were relatively small, esophageal reflux subscale ($\beta = -0.138$, $P < .001$), meal-related distress subscale ($\beta = -0.119$, $P < .001$), dumping subscale ($\beta = -0.078$, $P = .016$), total symptom score ($\beta = -0.090$, $P = .008$), change in body weight ($\beta = 0.096$, $P = .003$), ingested amount of food per meal ($\beta = 0.178$, $P < .001$), necessity for additional meals ($\beta = -0.078$, $P = .016$), ability for working ($\beta = -0.080$, $P = .011$), dissatisfaction

TABLE 3 Patient characteristics

	TG (n = 1020)	SRDG (n = 54)	P-value
Age (years), mean (SD)	68.3 (10.4)	67.8 (8.9)	.745
Postoperative period (months), mean (SD)	52.9 (36.5)	38.8 (23.6)	.005
Gender			.484
Male/female	743/ 277	37/ 17	
Preoperative BMI (kg/m ²), mean (SD)	23.1 (3.1)	23.0 (2.8)	.693
Postoperative BMI (kg/m ²), mean (SD)	19.7 (2.5)	20.4 (2.8)	.042
Abdominal approach			<.001
Open/Laparoscopy	611/409	8/46	
Celiac branch of vagus			.024
Preserved/Divided	19/974	4/48	
Tumor location (JGCA 14th)			<.001
UE (Siewert type III)/U/UM/MU	33/609/203/173	0/46/3/5	
cStage (JGCA 14th)			<.001
I	547	43	
IIA/IIB	196	8	
III	240	3	
IVA/IVB	33	0	
Chemotherapy			.007
Preoperative	20	0	
Postoperative	271	7	
Both	64	0	
None	662	47	
Extent of lymphnode dissection			.019
D0	1	0	
D1	10	0	
D1+	403	34	
D2	579	20	
D2+	23	0	
Combined resection			<.001
None	736	53	
Gallbladder	176	1	
Spleen	144	0	
Pancreas	16	0	
Others	17	0	

Abbreviations: BMI, body mass index; SD, standard deviation; SRDG, small remnant distal gastrectomy; TG, total gastrectomy.

with symptoms ($\beta = -0.086$, $P = .007$), dissatisfaction at the meal ($\beta = -0.119$, $P < .001$), dissatisfaction at working ($\beta = -0.111$, $P = .001$), dissatisfaction for daily life subscale ($\beta = -0.123$, $P < .001$), and physical component summary of SF-8 ($\beta = 0.112$, $P = .001$) were significantly better in the SRDG group than in the TG group. Abdominal pain subscale ($\beta = -0.061$, $P = .061$) showed a better tendency in the SRDG group than in the TG group. Age, sex, postoperative period, surgical approach, clinical stage, lymph node dissection, and combined resection of other organs also had a significant effect on numerous MOMs, whereas celiac branch preservation, and chemotherapy had no significant effect on the MOMs.

4 | DISCUSSION

The present study provides important insights into the potential benefits of leaving a small remnant stomach and esophagogastric junction in patients undergoing surgery for gastric cancer, an enduring uncertainty. In this cross-sectional study including 70 participating institutions across Japan, we found that the patients who underwent SRDG experienced a better QOL compared to those who underwent TG, based on improvements in 12 of the 19 MOMs of the PGSAS-45 by univariate analysis. Moreover, MRA indicated that the type of gastrectomy, ie, SRDG, was a significant

TABLE 4 The main outcomes measures following TG and SRDG

Domain	Main outcome measures	TG (n = 1020)		SRDG (n = 54)		t-test	
		Mean	SD	Mean	SD	P-value	Cohen's <i>d</i>
Symptoms	Esophageal reflux SS	2.1	1.0	1.5	0.6	<.001	0.55
	Abdominal pain SS	1.7	0.8	1.5	0.7	.084	0.24
	Meal-related distress SS	2.6	1.1	2.1	0.9	.001	0.46
	Indigestion SS	2.2	1.0	2.1	0.8	.519	
	Diarrhea SS	2.4	1.2	2.4	1.3	.843	
	Constipation SS	2.2	1.1	2.1	0.9	.502	
	Dumping SS	2.2	1.2	1.9	1.0	.061	0.28
	Total symptom score	2.2	0.8	2.0	0.6	.031	0.32
Living status	Change in BW*	-14.3%	8.9%	-10.9%	7.1%	.007	0.38
	Ingested amount of food per meal*	6.1	1.9	7.6	1.6	<.001	0.78
	Necessity for additional meals	2.4	0.9	2.2	0.9	.087	0.24
	Quality of ingestion SS*	3.6	1.0	3.8	1.0	.202	
	Ability for working	2.2	1.0	1.8	0.8	.004	0.41
QOL	Dissatisfaction with symptoms	2.0	1.0	1.7	0.8	.015	0.34
	Dissatisfaction at the meal	2.7	1.2	2.1	1.0	.001	0.49
	Dissatisfaction at working	2.1	1.1	1.6	0.8	<.001	0.50
	Dissatisfaction for daily life SS	2.3	1.0	1.8	0.7	<.001	0.52
	PCS of SF-8*	48.7	5.7	51.6	4.4	<.001	0.50
	MCS of SF-8*	49.4	6.2	51.1	4.7	.048	0.28

Note: Outcome measures with*; higher score indicating better condition. Outcome measures without*; higher score indicating worse condition.

The interpretation of effect size in Cohen's *d*: ≥ 0.2 as small, ≥ 0.5 as medium, ≥ 0.8 as large.

Abbreviations: BW, body weight; MCS, mental component summary; PCS, physical component summary; SRDG, small remnant distal gastrectomy; SS, subscale; TG, total gastrectomy.

independent factor which improved postoperative QOL in 13 of the 19 MOMs even after adjusting for various clinical factors. Our analyses also revealed that nonoperative factors including age, sex, and postoperative period had a considerable effect on postoperative QOL and that factors related to cancer progression had a relatively small effect.

Pervious PGSAS study comparing postoperative QOL between conventional distal gastrectomy (n = 475) with Roux-en-Y reconstruction and TG (n = 393) for stage I gastric cancer reported that distal gastrectomy with Roux-en-Y reconstruction maintained a better QOL in 15 of the 19 MOMs in the PGSAS-45 compared with TG based on MRA. Similarly, in the present study we utilized MRA to demonstrate that the QOL was better with SRDG than TG based on 13 of the 19 MOMs in the PGSAS-45, despite the more limited reservoir capacity with SRDG compared with conventional distal gastrectomy and the insufficient detection power due to the small number of cases in the SRDG group (n = 54). We also compared the effect sizes of these MOMs to identify specific MOMs that were most sustained by the rather small gastric remnant created by SRDG. Our analyses revealed that the MOMs that were favorably affected were (in decreasing order) ingested amount of food per meal, esophageal reflux subscale, dissatisfaction for daily life subscale, meal-related distress subscale, dissatisfaction at the meals, physical component summary of SF-8, dissatisfaction for working,

change in body weight, total symptom score, dissatisfaction with symptoms, ability for working, necessity for additional meals, and dumping subscale. Nakada et al¹⁷ reported that total symptom score, ability for working, and necessity for additional meals were crucial clinical factors associated with worse postgastrectomy QOL and that the meal-related distress and dumping subscales were strongly associated with deterioration in most of the MOMs belonging to the living status and QOL domains among the seven symptom subscales of the PGSAS-45. Since SRDG maintained these important MOMs, the QOL after SRDG might also be well preserved.

Patient-reported outcome measures are often used to compare QOL between various gastrectomy procedures. A combination of the 36-Item Short Form Health Survey (SF-36) and GSRS is one such questionnaire,^{19,20} but GSRS tends to overlook certain important symptoms, such as meal-related distress and dumping, which are specific to patients who undergo gastrectomy. Questionnaires such as the EORTC QLQ-C30²¹ and STO-22²² have been developed to assess the QOL of patients with cancer undergoing treatment; however, these scales cannot adequately assess several important symptoms of postgastrectomy syndrome. The PGSAS-45 is a self-reported questionnaire that provides a comprehensive assessment of outcomes in patients undergoing surgery for gastric cancer. This questionnaire contains questions on well-known symptoms that considerably affect the QOL of patients and are adequate for

TABLE 5 All outcome measures analyzed using multiple regression analysis

Domain	Main outcome measures	Type of gastrectomy [SRDG]		Age (years)		Sex [Male]		Postoperative period (Mons)		Approach [Laparoscopic]	
		β	P value	β	P value	β	P value	β	P value	β	P value
Symptoms	Esophageal reflux SS	-0.138	<.001	-0.084	.007					0.095	.012
	Abdominal pain SS	-0.061	.061	-0.057	.074	-0.101	.001	-0.058	.069	0.028	.002
	Meal-related distress SS	-0.119	<.001	-0.107	.001	-0.061	.051	-0.073	.021	0.040	<.001
	Indigestion SS			-0.091	.004			-0.127	<.001		
	Diarrhea SS			-0.122	<.001	0.102	.001				
	Constipation SS			0.089	.005						
	Dumping SS	-0.078	.016	-0.193	<.001	-0.111	.001			0.071	.069
	Total symptom score	-0.090	.008	-0.136	<.001			-0.077	.021		
Living status	Change in BW*	0.096	.003	-0.118	<.001						
	Ingested amount of food per meal*	0.178	<.001	-0.103	.001						
	Necessity for additional meals	-0.078	.016	0.098	.002	-0.061	.052	-0.062	.050	0.078	.042
	Quality of ingestion SS*					-0.057	.072				
	Ability for working	-0.080	.011	0.251	<.001						
QOL	Dissatisfaction with symptoms	-0.086	.007	-0.091	.004	-0.089	.004	-0.099	.002		
	Dissatisfaction at the meal	-0.119	<.001	-0.099	.002			-0.094	.003	0.071	.058
	Dissatisfaction a working	-0.111	.001					-0.055	.078	0.068	.073
	Dissatisfaction for daily life SS	-0.123	<.001	-0.083	.008			-0.096	.002	0.075	.046
	PCS of SF-8*	0.112	.001	-0.096	.002						
	MCS of SF-8*	0.065	.042								

Note: Outcome measures with*; higher score indicating better condition.

Outcome measures without*; higher score indicating worse condition.

If β is positive, the score of the outcome measure of the patients belonging to the category in [brackets] is higher in cases when the factor is a nominal scale, and the score of outcome measure of the patients with larger values is higher in cases when the factor is a numeral scale.

The interpretation of effect size in β : ≥ 0.1 as small, ≥ 0.3 as medium, ≥ 0.5 as large.

The interpretation of effect size in R^2 : ≥ 0.02 as small, ≥ 0.13 as medium, ≥ 0.26 as large.

Abbreviations: [Y], yes; BW, body weight; CTx, chemotherapy; LN, lymphnode; MCS, mental component summary; PCS, physical component summary; SRDG, small remnant distal gastrectomy; SS, subscale.

clinical evaluation.²³ We used the PGSAS-45 in the present study, which therefore should be considered to have adequately evaluated postgastrectomy syndrome and the QOL in patients undergoing gastrectomy.

It has been well documented that distal gastrectomy is superior to TG in terms of postoperative QOL and nutritional status; however, data demonstrating the superiority of SRDG, in which very small remnant stomach is preserved, are limited.^{24–29} Kosuga et al reported that laparoscopic SRDG exhibited a significant advantage over laparoscopic TG regarding postoperative nutritional status.⁶ In the present survey, in addition to several QOL scores of the PGSAS-45, the scores for postoperative dietary intake and weight loss were better after SRDG compared with TG, even though the volume of remnant stomach in SRDG would be extremely small compared with conventional distal gastrectomy. Preservation of other important functions such as maintaining an antireflux mechanism by preserving lower esophageal sphincter or a relatively well-maintained serum ghrelin level in addition to a smaller reservoir function might have contributed to the improved QOL score in SRDG found in the present study.

There are several reasons other than better QOL and nutritional status for the preference of SRDG over TG, including the prevention of reflux and stable short-term results.^{6,7} Kosuga et al reported that 8.2% of the patients who underwent laparoscopic TG experienced severe reflux esophagitis, which was not observed in patients who underwent laparoscopic SRDG. Additionally, the authors reported higher rates of postoperative complications in the laparoscopic TG group than in the laparoscopic SRDG group, especially anastomotic leakage and stricture which are related to technical difficulties of esophagojejunal anastomosis within the narrow space of the esophagojejunal junction. Furukawa et al also found that laparoscopic SRDG was associated with favorable endoscopic findings with low-grade remnant gastritis and bile reflux compared with laparoscopic proximal gastrectomy. These findings suggest that the small remnant stomach might be functioning after SRDG.

Preserving a very small remnant stomach in surgery for gastric cancer surgery raises concerns regarding oncological safety. SRDG is recommended if the proximal surgical margin can be secured with the strict confirmation of accurate preoperative diagnosis; however,

Celiac branch of vagus [Preserved]		CTx [Y]		cStage [III/IV]		LN dissection [D1+]		LN dissection [D2/D2]		Combined resection [Y]		R2	P value
β	P value	β	P value	β	P value	β	P value	β	P value	β	P value		
0.042	<.001												
						-0.063	.042					0.035	<.001
						-0.072	.021			0.065	.054	0.036	<.001
										0.077	.024	0.018	.067
						-0.102	.002					0.078	<.001
						-0.100	.003			0.071	.051	0.052	<.001
				0.101	.008	-0.054	.083	0.097	0.013			0.059	<.001
				0.088	.021					-0.094	.005	0.053	<.001
												0.029	.002
												0.008	.659
				0.063	.090					0.058	.080	0.082	<.001
										0.071	.036	0.040	<.001
										0.061	.070	0.038	<.001
						-0.054	.088			0.061	.075	0.025	.007
										0.076	.025	0.038	<.001
		0.065	.096			0.058	.064					0.030	.001
												0.013	.253

it was still unclear. Kano et al reported the oncological feasibility of laparoscopic SRDG compared with laparoscopic proximal gastrectomy or TG for cT1N0 gastric cancer in proximal stomach.³⁰ In that study, the width of the pathological margin was significantly shorter in patients who underwent laparoscopic SRDG than in those who underwent other procedures and none of the patients who underwent any of the procedures had metastases in no. 2 or 4sa lymph nodes, which were retrieved only during proximal stomach resection. Therefore, great care is warranted to obtain an adequate surgical margin during SRDG in patients with advanced gastric cancer in the proximal stomach.

One of interests on optimal method of surgical resection in the upper-third early gastric cancer will be comparison of SRDG with proximal gastrectomy (PG). When the occupied area of the upper part of the stomach is divided into three equal parts, the proximal part is indicated for PG and the distal part is indicated for SRDG. The intermediate site would be a competing occupied site for PG and SRDG. Therefore, it seems that there are not a few cases where the indications overlap. As an evaluation between

surgical procedures of PG and SRDG, it is important to first investigate whether the superiority in each procedure can be shown in comparison with TG, and in which evaluation factors and how large effect it is. Comparing competing SRDG and PG would be the next step. Whether to perform PG or SRDG for patients to whom either procedure is indicated depends on the policy of the institution and the preference of the surgeon. There is a need for future verification.

The present study has several limitations. First, the number of patients in the SRDG and TG groups were not matched due to the retrospective study design. However, the present study included a relatively high number of patients than previous studies analyzing the effect of small remnant stomach on QOL after distal gastrectomy. Of the 70 institutions that participated in the PGSAS NEXT study, only 7 had enrolled cases of SRDG (data not shown). However, the QOL of SRDG would be better than that of TG, and it is expected that SRDG will become widespread in the future. Second, selection bias regarding the type of resection used, SRDG or TG, cannot be ruled out. Since surgeons and institutions are likely to use

their preferred techniques according to each indication for proximal stomach, a randomized controlled trial is required to eliminate potential biases.

In conclusion, the results of the present study indicated that SRDG might be beneficial in improving postoperative QOL and reducing the symptoms of postgastrectomy syndrome in patients undergoing surgery for early-stage gastric cancer in upper-third of the stomach.

ACKNOWLEDGEMENT

This study was conducted by the Japan Postgastrectomy Syndrome Working Party. The authors thank all physicians and patients who participated in the study; their cooperation made this study possible.

DISCLOSURE

Funding: This study was supported by a grant from the Jikei University and the Japanese Gastric Cancer Association.

Conflict of Interest: The authors declare that they have no conflicting interests regarding the content and application of this paper. This study was supported by a grant from Jikei University and the Japanese Gastric Cancer Association.

Approval of the Research Protocol: The protocol for this study has been approved by a suitably constituted Ethics Committee of all participating institutions.

Informed Consent: Written informed consent was obtained from all enrolled patients.

Registry and the Registration No. of the study/Trial: The University Hospital Medical.

Information Network Clinical Trials Registry (registration number 000 032 221).

Animal Studies: N/A.

ORCID

Souya Nunobe  <https://orcid.org/0000-0003-3012-5632>

REFERENCES

- Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. *CA Cancer J Clin*. 2011;61:69–90.
- Nashimoto A, Akazawa K, Isobe Y, Miyashiro I, Katai H, Kodera Y, et al. Gastric cancer treated in 2002 in Japan: 2009 annual report of the JGCA nationwide registry. *Gastric Cancer*. 2013;16:1–27.
- Deans C, Yeo MS, Soe MY, Shabbir A, Ti TK, So JB. Cancer of the gastric cardia is rising in incidence in an Asian population and is associated with adverse outcome. *World J Surg*. 2011;35:617–24.
- Zhou Y, Zhang Z, Zhang Z, Wu J, Ren D, Yan X, et al. A rising trend of gastric cardia cancer in Gansu Province of China. *Cancer Lett*. 2008;269:18–25.
- Ahn HS, Lee HJ, Yoo MW, Jeong SH, Park DJ, Kim HH, et al. Changes in clinicopathological features and survival after gastrectomy for gastric cancer over a 20-year period. *Br J Surg*. 2011;98:255–60.
- Kosuga T, Hiki N, Nunobe S, Noma H, Honda M, Tanimura S, et al. Feasibility and nutritional impact of laparoscopy-assisted subtotal gastrectomy for early gastric cancer in the upper stomach. *Ann Surg Oncol*. 2014;21:2028–35.
- Furukawa H, Kurokawa Y, Takiguchi S, Tanaka K, Miyazaki Y, Makino T, et al. Short-term outcomes and nutritional status after laparoscopic subtotal gastrectomy with a very small remnant stomach for cStage I proximal gastric carcinoma. *Gastric Cancer*. 2018;21:500–7.
- Nakauchi M, Suda K, Nakamura K, Shibasaki S, Kikuchi K, Nakamura T, et al. Laparoscopic subtotal gastrectomy for advanced gastric cancer: technical aspects and surgical, nutritional and oncological outcomes. *Surg Endosc*. 2017;31:4631–40.
- Takahashi M, Terashima M, Kawahira H, Nagai E, Uenosono Y, Kinami S, et al. Quality of life after total vs distal gastrectomy with Roux- en- Y reconstruction: use of the postgastrectomy syndrome assessment scale- 45. *World J Gastroenterol*. 2017;23:2068–76.
- Nakada K, Ikeda M, Takahashi M, Kinami S, Yoshida M, Uenosono Y, et al. 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;18:147–58.
- 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;12:1003–12.
- Svedlund J, Sjodin 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;33:129–34.
- Namikawa T, Hiki N, Kinami S, Okabe H, Urushihara T, Kawahira H, et al. Factors that minimize postgastrectomy symptoms following pylorus-preserving gastrectomy: assessment using a newly developed scale (PGSAS-45). *Gastric Cancer*. 2015;18(2):397–406.
- Tanizawa Y, Tanabe K, Kawahira H, Fujita J, Takiguchi N, Takahashi M, et al. 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(2):94–103.
- Tanabe K, Takahashi M, Urushihara T, Nakamura Y, Yamada M, Lee S-W, et al. Predictive factors for body weight loss and its impact on quality of life following gastrectomy. *World J Gastroenterol*. 2017;23(26):4823–30.
- Kinami S, Takahashi M, Urushihara T, Ikeda M, Yoshida M, Uenosono Y, et al. Background factors influencing postgastrectomy syndromes after various types of gastrectomy. *World J Clin Cases*. 2018;26:1111–20.
- Tanaka C, Kanda M, Murotani K, Yoshikawa T, Cho H, Ito Y, et al. Long-term quality of life and nutrition status of the aboral pouch reconstruction after total gastrectomy for gastric cancer: a prospective multicenter observational study (CCOG1505). *Gastric Cancer*. 2019;22(3):607–16.
- Okubo K, Arigami T, Matsushita D, Sasaki K, Kijima T, Noda M, et al. Evaluation of postoperative quality of life by PGSAS-45 following local gastrectomy based on the sentinel lymph node concept in early gastric cancer. *Gastric Cancer*. 2020;23(4):746–53.
- Hayami M, Seshimo A, Miyake K, Shimizu S, Kameoka S. Effects of emptying function of remaining stomach on QOL in postgastrectomy patients. *World J Surg*. 2012;36(2):373–8.
- Kono K, Iizuka H, Sekikawa T, Sugai H, Takahashi A, Fujii H, et al. Improved quality of life with jejunal pouch reconstruction after total gastrectomy. *Am J Surg*. 2003;185(2):150–4.
- Aaronson NK, Ahmedzai S, Bergman B, Bullinger M, Cull A, Duez NJ, et al. 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(5):365–76.
- Vickery CW, Blazeby JM, Conroy T, Arraras J, Sezer O, Koller M, et al. Development of an EORTC disease-specific quality of life module for use in patients with gastric cancer. *Eur J Cancer*. 2001;37(8):966–71.
- Nakada K, Takahashi M, Ikeda M, Kinami S, Yoshida M, Uenosono Y, et al. Factors affecting the quality of life of patients after gastrectomy as assessed using the newly developed PGSAS-45 scale: a nationwide multi-institutional study. *World J Gastroenterol*. 2016;22:8978–90.
- Kobayashi D, Kodera Y, Fujiwara M, Koike M, Nakayama G, Nakao A. Assessment of quality of life after gastrectomy using EORTC QLQ-C30 and STO22. *World J Surg*. 2011;35:357–64.

25. Nakamura M, Hosoya Y, Yano M, Doki Y, Miyashiro I, Kurashina K, et al. Extent of gastric resection impacts patient quality of life: the dysfunction after upper gastrointestinal surgery for cancer (DAUGS32) scoring system. *Ann Surg Oncol*. 2011;18:314–20.
26. Davies J, Johnston D, Sue-Ling H, Young S, May J, Griffith J, et al. Total or subtotal gastrectomy for gastric carcinoma? A study of quality of life. *World J Surg*. 1998;22:1048–55.
27. Korenaga D, Orita H, Okuyama T, Moriguchi S, Maehara Y, Sugimachi K. Quality of life after gastrectomy in patients with carcinoma of the stomach. *Br J Surg*. 1992;79:248–50.
28. Anderson ID, MacIntyre IM. Symptomatic outcome following resection of gastric cancer. *Surg Oncol*. 1995;4:35–40.
29. Bozzetti F, Ravera E, Cozzaglio L, Dossena G, Agradi E, Bonfanti G, et al. Comparison of nutritional status after total or subtotal gastrectomy. *Nutrition*. 1990;6:371–5.
30. Kano Y, Ohashi M, Ida S, Kumagai K, Nunobe S, Sano T, et al. Oncological feasibility of laparoscopic subtotal gastrectomy compared with laparoscopic proximal or total gastrectomy for cT1N0M0 gastric cancer in the upper gastric body. *Gastric Cancer*. 2019;22:1060–8.

How to cite this article: Nunobe S, Takahashi M, Kinami S, Fujita J, Suzuki T, Suzuki A, et al. Evaluation of postgastrectomy symptoms and daily lives of small remnant distal gastrectomy for upper-third gastric cancer using a large-scale questionnaire survey. *Ann Gastroenterol Surg*. 2022;6:355–365. doi:[10.1002/ags3.12536](https://doi.org/10.1002/ags3.12536)