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Original Article

Changes in Eating Behaviors and Physical and Mental State of Gastric Cancer Patients during the First 6 Months after Surgery

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Abstract

Purpose : To quantitatively assess and clarify the relationships between eating behaviors, physical symptoms, and depression over 6 months postoperatively in patients who have undergone gastrectomy for gastric cancer.

Methods : Questionnaire surveys to post-gastrectomy patients on eating behavior, post-gastrectomy dysfunction (DAUGS), and depression (CES-D) were conducted five times during the 6 months after surgery (before discharge, and 2 weeks, 6 weeks, 3 months, and 6 months after surgery). The longitudinal changes of each item were analyzed using a repeated measure ANOVA, and the relationships between post-gastrectomy dysfunction and patient factors were analyzed using a two-way ANOVA. The relationships between depression and post-gastrectomy dysfunction were analyzed using correlations.

Results : The subjects were 64 post-gastrectomy patients. The mean age was 66.5 (*SD* 10.3) years and 40 were males. Forty-six patients had distal gastrectomy. Fifty-three were diagnosed as gastric cancer stage I. The participants' body weight had decreased by about 10% at 6 months after surgery ($p < .001$). Although the patients who practiced eating behavior modifications such as food adjustment decreased from 80% to 50% at 6 months after surgery, food intake was recovered up to about 80% of the pre-operative intake. Post-gastrectomy dysfunction (DAUGS) was the worst at 2 weeks after surgery and improved significantly within 6 months ($p < .05$). The factors that were associated with significantly worse post-gastrectomy dysfunction were being employed and high depression groups. The post-gastrectomy dysfunction in the high depression group was worse than in the low depression group throughout the 6 months.

Conclusion : Post-gastrectomy dysfunction worsened immediately after discharge and was alleviated over 6 months, and a relationship between physical and depressive states was observed. Medical staff should be better to understand patients' depressive state during hospitalization and continue to

observe the post-gastrectomy dysfunction early postoperative period.

Key words : gastric cancer, post-gastrectomy dysfunction, depression, eating behaviors, longitudinal study

Introduction

It is estimated that one in two people in Japan will develop some kind of cancer during their lifetime. Gastric cancer is the most common cancer in Japanese persons¹⁾. Among organ cancers, its morbidity and mortality were ranked second, following colon cancer, in 2014, and third, following lung and colon cancer, in 2017²⁾. Although 45,000 gastric cancer patients died in 2017²⁾, the number of deaths has been decreasing because of advances in treatment and the spread of screening methods for early gastric cancer. This also means that the number of survivors living with gastric cancer is increasing.

Gastric capacity decreases after gastrectomy, and various symptoms such as diarrhea and dumping symptoms occur because of the decreased food intake and weight loss associated with it, as well as decreased digestive functions. Even 2 years after surgery, 40% of patients are still troubled by sequelae such as food being stuck in the throat and diarrhea, and even after 5 years, food regurgitation and dietary restrictions as well as malaise still remain³⁾⁻⁷⁾. As many post-gastrectomy symptoms arise in direct relation to the difference in function depending on gastrectomy type and eating behaviors, understanding these symptoms and devising more appropriate ways to eat is critical to managing these issues. However, due to individual differences in the frequency and extent of symptoms, it is difficult to predict their incidence, and many patients struggle to manage them due to lack of knowledge and understanding on their diseases. Furthermore, because of the shortening of hospitalization times due to changes in treatment and healthcare provision systems, patients have less contact with healthcare professionals. They return to their homes without adequate self-care practices, such as appropriate

eating habits, required to live out their daily lives. It has been reported that in such situations, patients who receive regular nutritional guidance and practice what they learn adapt quicker to the new diet requirements⁸⁾, and through partnership with nurses, this may lead to improvement of the diet and alleviation of functional disorders after surgery⁹⁾. To help gastric cancer patients to live smoothly after undergoing gastrectomy, promoting their self-care is important in addition to addressing differences in cancer treatments and postoperative symptoms¹⁰⁾¹¹⁾, moreover, providing continuous nursing support is necessary to achieve this¹²⁾. Self-care is the practice of activities that individuals intentionally conduct in order to maintain their health and well-being. Diseases, surgery, and mental and physical dysfunction limit what people can do on their own¹³⁾. In other words, in order to successfully perform self-care, it is necessary for patients to fully grasp their own physical condition and maintain a stable mental state.

The physical condition of post-gastrectomy patients can be evaluated by combining a general health-related QOL scale, such as Function Assessment of Cancer Therapy-General (The FACT-G) or the European Organization for Research and Treatment of Cancer (EORTC) QLQ-C30, with a scale specific to gastric cancer, such as QLQ-STO22 or an original questionnaire developed to examine postoperative symptoms³⁾⁻⁶⁾¹⁴⁾¹⁵⁾. Since these scales were developed for the purpose of QOL assessment of relatively high-severity cancer patients, they include questions for patients who have undergone chemotherapy or radiotherapy. Furthermore, they do not include questions regarding specific symptoms for post-gastrectomy patients such as dumping symptoms. Most previous studies investigated post-gastrectomy patients after 1-3

months or more, and the participants were evaluated over a relatively long period of time, such as yearly^{4)–6)15)}. In addition, few studies have examined longitudinal details for a short period of time immediately after surgery, and the study populations were limited⁹⁾¹⁰⁾. Regarding the mental state of gastric cancer patients, negative thinking, anxiety, and depression have been reported to be associated with poor QOL and to be related to the frequency of postoperative symptoms of gastric cancer patients^{16)–18)}. Depression levels influenced self-care self-efficacy among gastric and colorectal cancer patients¹⁹⁾. Moreover, psychological distress is common in patients of all gastric cancer stages, and has been reported to be associated with worse outcomes²⁰⁾.

In recent years, gastric cancer patients have been discharged approximately one week after their gastrectomy. This means that patients return home at a period when they used to be hospitalized. Little is known about the details of subsequent changes in symptoms and mental state that are affected by treatment during this period, such as postoperative diagnosis and initiation of adjuvant chemotherapy while aiming for a return to social life. By understanding patients' post-gastrectomy symptoms and attending to their depression levels, medical staff can help improve their QOL and support their self-care.

The purpose of this study was to quantitatively assess and clarify the relationships between eating behaviors, physical symptoms, and depression over 6 months postoperatively in patients who have undergone gastrectomy for gastric cancer.

Materials and Methods

1. Design, sample, and setting

This study was a 6-month longitudinal questionnaire study. We recruited 74 patients undergoing gastrectomy between August 2014 and June 2016 at three cancer centers in Japan. All

participants provided their written consent after the researchers explained the study protocol to patients in each hospital. We gathered data up to 6 months after surgery. The inclusion criteria were patients with gastric cancer in stages I – III undergoing any type of gastrectomy (total, distal, or proximal). Endoscopic resection was excluded. The recruitment of participants was performed by physicians at the research cooperative hospitals. The exclusion criteria were patients who were not able to answer the questionnaires due to dementia or serious mental diseases.

This study was conducted with the approval of the Ethical Review Board of Kyushu University (Approval number : 26-314) and of all the collaborating hospitals.

2. Study procedure

This longitudinal survey included self-administered questionnaire conducted five times during the period that begins before discharge and ends 6 months after surgery. Before discharge and after surgery, we explained the purpose of the study and methods for answering using documentation and verbal instructions. At this time, the patients completed the initial survey for baseline data of the longitudinal study (hereinafter referred to as “before discharge”). Subsequently, 2 weeks, 6 weeks, 3 months, and 6 months after surgery, patients completed the same questionnaire. Post-gastrectomy patients are discharged almost 1 week after surgery due to shortened hospital stays. Two weeks after surgery, which was previously the time set for treatments in the hospital, was set as the second survey point (hereinafter referred to as “2 weeks”). The third survey time was 6 weeks after surgery, when postoperative diagnosis, such as cancer histology, is confirmed, and adjuvant chemotherapy is decided upon and started (hereinafter referred to as “6 weeks”). The fourth survey time was 3 months after surgery, when the patient has almost recovered from severe postoperative symptoms (hereinafter referred to as “3 months”),

and the fifth time was set at 6 months after surgery, when the patient generally returns to society (hereinafter referred to as "6 months").

After discharge, we reconfirmed the continuation of participation in the survey by phone call before the investigation date, and distributed and collected the questionnaire by mail.

3. Measurements & Questionnaires

1) Information concerning patients' age, gender, weight at time of hospitalization, disease history (surgery date, gastrectomy type, postoperative course details, postoperative cancer stage, and adjuvant chemotherapy), family structure, and employment status was obtained from medical records.

2) The survey of eating behaviors (eating behavior-survey) contained four question items developed according to previous studies⁸⁾ concerning the number of meals taken and dietary habits (whether they ate at a relaxed pace, adjusted their food intake so as not to overeat, felt hunger, and how their meal intake compared to that in the preoperative period), which were evaluated on a 4-point scale.

3) Participants' physical and mental states were investigated using the following scales. Regarding the physical condition, the 32-item Dysfunction After Upper Gastrointestinal Surgery (DAUGS) scale developed by Nakamura et al. (2008) was used²¹⁾. To assess the mental state, the Center for Epidemiologic Studies Depression Scale (CES-D) was used²²⁾²³⁾. Administrations were carried out applying the appropriate procedures for each scale, such as developer use license agreements.

(1) Assessment of post-gastrectomy symptoms

The DAUGS scale was the first tool to objectively evaluate post-gastrectomy dysfunction developed by patients with upper gastrointestinal cancers (gastric/esophageal cancer)²¹⁾²⁴⁾. It contains questions about many symptoms peculiar to gastrectomies and has been judged to be an optimal measure for understanding detailed

changes in the physical condition of post-gastrectomy patients. The scale consists of 32 items divided in 7 subscales, namely "regurgitation/reflux (4 items)," "limited activity due to decreased food consumption (6 items)," "passage dysfunction immediately after eating (7 items)," "dumping-like symptoms (7 items)," "transfer dysfunction/deglutition disturbance (4 items)," "hypoglycemic symptoms (2 items)," and "diarrhea-like symptoms (2 items)." Question items are rated on a 5-point scale (1 : None/Never, 2 : Slight/Rarely, 3 : Moderate/Often, 4 : Severe/Very Often, or 5 : Very Severe/Constant). Higher total scores indicate a more pronounced extent of dysfunction. The total score range is 32-160 points. In order to analyze the influencing factors for post-gastrectomy dysfunction, the DAUGS score was examined based on overall and patient characteristics, factors related to gastric cancer, and depressive state. We divided the participants into a total gastrectomy group ($n=15$), undergoing total gastrectomy, and the subtotal gastrectomy group, undergoing distal and proximal gastrectomy ($n=49$), and examined post-gastrectomy dysfunction, weight and eating behavior.

(2) Assessment of depression

We hypothesized that depressed mood affects engagement in intentional self-care, and we used the Japanese version of the well-known 20-item CES-D to evaluate depression. Question items are rated as A : Rarely or none of the time (less than 1 day during the past week), B : Some or a little of the time (1-2 days), C : Occasionally or a moderate amount of time (3-4 days), and D : Most or all of the time (5-7 days). Answers are scored as follows : A = 0 points, B = 1 point, C = 2 points, D = 3 points. Scoring is reversed for 4 of the 20 question items. As per the CES-D scoring manual²⁵⁾, a higher score indicates more pronounced depressive tendencies, and the existence of a depressive tendency is believed to begin at 16 points. The score range is 0-60 points. In this study, participants were divided into a low-depression group ($n=50$) and a high-depression

group ($n=14$) based on CES-D scores at before-discharge using the cutoff point of 16. We examined post-gastrectomy dysfunction, weight, and eating behavior of those depression groups.

4. Statistical analysis

Descriptive statistics were calculated for all variables. Independent t -tests for the continuous variables and chi-square tests for the categorical variables were conducted to compare the two groups. To evaluate the responses on the eating behavior-survey (i.e., whether patients ate at a relaxed pace, and adjusted their food intake so as not to overeat), we divided the participants into a practicing group (i.e., those who responded “always yes” and “often yes”), and a non-practicing group (i.e., those who responded “sometimes no” and “no”). We examined the relationships between DAUGS scores and responses on the eating behavior-survey using the Spearman rank correlation coefficient at each time point. The longitudinal changes of variables were analyzed using repeated measure analysis of variance (ANOVA) with mixed models. The relationship between DAUGS and CES-D scores was analyzed using Pearson’s correlation coefficient. To explore factors related to post-gastrectomy dysfunction, patient factors (attributes, cancer-related information, and depression levels) and changes over time in DAUGS scores were analyzed using a two-way ANOVA with a mixed model. A Bonferroni test was used in post-hoc analyses. SPSS (Japanese version 23.0 for Windows, IBM Japan, Inc., Tokyo) was used for statistical analyses. A p -value of less than 0.05 was considered statistically significance in all tests.

Results

We describe the survey results of all 64 subjects in the order of eating behavior, physical condition, and mental state. After that, we show whether differences in employment status, gastrectomy type, adjuvant chemotherapy, and depressive status affect the physical condition (DAUGS) over

time.

1. Patient characteristics and gastric cancer information (Table 1)

A total of 74 post-gastrectomy patients were enrolled prior to study initiation (Fig. 1). Of the total, 64 were able to complete the study 6 months post-gastrectomy. The ratio of severe cases was higher in the dropout group ($n=10$) than in the complete group ($n=64$; $p < .001$). The mean age was 66.5 (Standard deviation : SD 10.3) years ; 70% were men ; 95% underwent laparoscopic surgery ; 77% had subtotal gastrectomy (46 distal and 3 proximal gastrectomy). Gastric cancer stage I according to postoperative diagnosis included in 83% of the participants. Of the patients diagnosed with stage II or stage III cancer, eight underwent postoperative adjuvant chemotherapy. Six of those eight patients experienced various side effects but continued chemotherapy during the study period, and two discontinued chemotherapy due to strong side effects.

At the time of hospitalization, participants’ mean body weight was 59.6 (SD 11.3) kg. Body

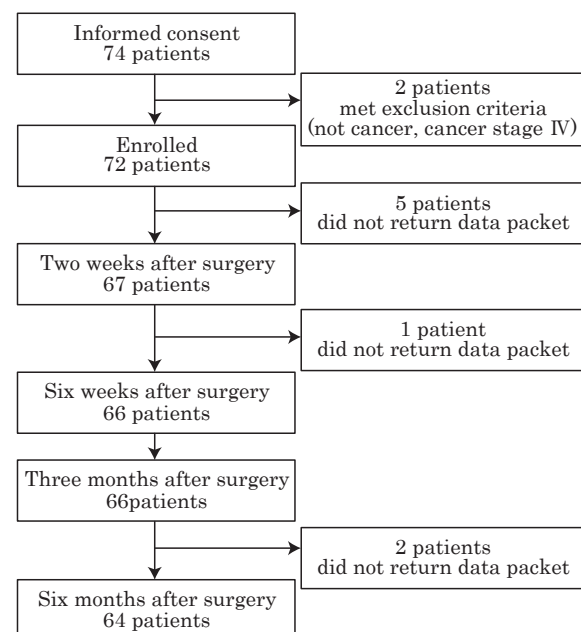


Fig. 1 Flow chart
Number of patients who returned the data packet at each time point.

Table 1 Patient characteristics and gastric cancer related information (Completed group vs. Dropped out group)

	Complete (n=64)	Dropout (n=10)	<i>p</i> -value
Age (year)	66.5 ± 10.3 (40-90)	62.8 ± 10.3 (38-80)	.320
<65 years old	24 (37.5)	4 (40.0)	.570
≥65 years old	40 (62.5)	6 (60.0)	
Gender			
Male	40 (62.5)	5 (50.0)	.451
Female	24 (37.5)	5 (50.0)	
Living with others	54 (84.4)	8 (80.0)	.661
Employed	29 (45.3)	5 (50.0)	.782
Initial Weight (kg)	59.9 ± 11.4 (40.1-90.7)	61.2 ± 13.6 (44.1-82.7)	.738
Initial BMI (kg/m²)	23.0 ± 3.0 (17.7-29.6)	24.0 ± 2.9 (18.8-29.1)	.321
Approach			
Open	3 (4.7)	1 (10.0)	.448
Laparoscopic	61 (95.3)	9 (90.0)	
Gastrectomy type			
Total gastrectomy	15 (23.4)	4 (40.0)	.268
Subtotal gastrectomy	49 (76.6)	6 (60.0)	
Cancer stage			
I	53 (82.8)	3 (30.0)	.000
II	8 (12.5)	2 (20.0)	
III	3 (4.7)	3 (30.0)	
IV	0 (0.0)	1 (10.0)	
Not cancer	0 (0.0)	1 (10.0)	
Adjuvant chemotherapy	8 (12.5)	2 (20.0)	.056

Values are presented as mean ± standard deviation (range) or number (%).

weight significantly decreased continuously, falling from 57.9 (*SD* 10.9) kg before discharge to 54.3 (*SD* 10.3) kg at 6 months ($p < .001$). The breakdown of participants' body weight as a percentage of their weight at the time of hospitalization was indicating an average decrease of approximately 10% over the 6 months. There was a difference in the weight loss rate between the gastrectomy types. The weight of the participants in the subtotal gastrectomy group decreased by 8% after 6 months, and that of those in the total gastrectomy group decreased by 14% ($p < .001$).

2. Changes in eating behaviors

A total of 80% of participants had 5 or more

meals per day during the 2 weeks immediately after discharge. Although this number subsequently decreased gradually, by postoperative month 6, approximately 50% of participants had 5 or more meals per day, approximately 20% had 4-3 meals per day, and 10% had 6 or more meals per day.

Participants were asked to report whether they ate at a relaxed pace (Fig. 2A), adjusted their food intake so as not to overeat (Fig. 2B), or felt hunger (Fig. 2C), as well as how their meal intake compared to that in the preoperative period (Fig. 2D). Although 90% of participants responded "always" or "often" at postoperative week 2 to whether they ate at a more relaxed pace, this figure gradually decreased to 50% of participants

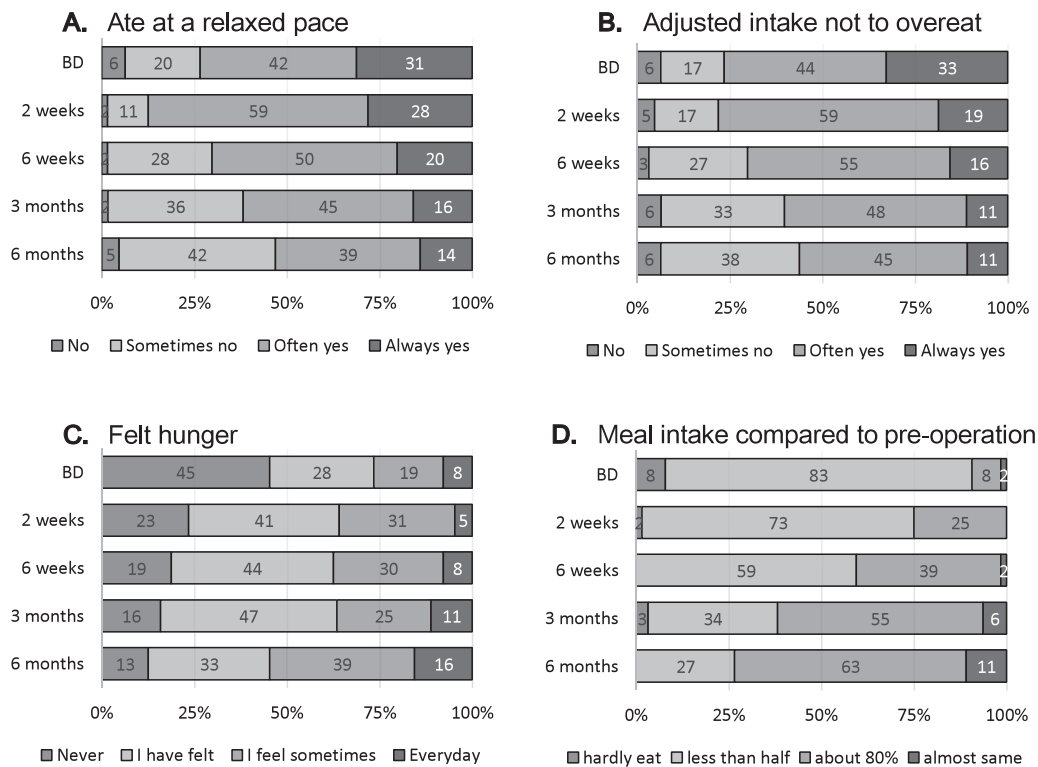


Fig. 2 Changes in eating behaviors
Frequencies and changes at each time point regarding dietary habits, participants who reported that they ate at a relaxed pace (A), adjusted intake not to overeat (B), and felt hunger (C), and how their meal intake compared with that in the preoperative period (D). BD, before discharge ; approximately 1 week post-gastrectomy, 2 weeks, 6 weeks, 3 months, 6 months ; time after gastrectom.

by postoperative month 6 (Fig. 2A). Similarly, while 80% of participants responded at postoperative week 2 that they adjusted their food intake so as not to overeat, by postoperative month 6, this figure fell to 56% (Fig. 2B). Regarding hunger sensation, while 45% of participants responded “never” before discharge, this figure decreased to 13% at 3 months, and by postoperative month 6 nearly all participants experienced a hunger sensation at some point (Fig. 2C). A total of 70% responded at postoperative week 2 that they ate smaller meals than before surgery. Meal size gradually increased, and by postoperative month 6, many participants were able to eat over 80% of their preoperative portion size, but 30% reported being able to eat less than half of their meal size of before surgery (Fig. 2D).

We compared eating behaviors between groups of patient factors (gastrectomy type, adjuvant

chemotherapy, depression level), but no significant differences were found. At 3 months and 6 months, employed people could not significantly eat at a relaxed pace ($p=.005$ at 3 months, $.027$ at 6 months). The percentage of people who could eat 80% or more of their preoperative intake was significantly higher in the subtotal gastrectomy group (70%) compared to 35% in the total gastrectomy group, and in the non-chemotherapy group (70%) than chemotherapy group (12%) after 3 months ($p=.022$, $.004$, respectively).

3. Physical condition (post-gastrectomy dysfunction)

Changes over 6 months in the DAUGS total and subscale scores are shown in Table 2. The range of Cronbach’s alpha coefficient at the 5 investigation time points of DAUGS total and 7 subscale scores were following : DAUGS total ; 0.87-0.91,

Table 2 DAUGS scores following up to 6 months post-gastrectomy (n=64)

	Before discharge	2 weeks	6 weeks	3 months	6 months	<i>p</i> -value
DAUGS Total	51.8±12.9	55.1±13.1	53.7±13.3	52.5±12.9	50.3±11.9	.012 2w > 6m*
DAUGS Subscales						
Regurgitation/Reflux						
	4.4± 1.3	4.6± 1.2	5.0± 1.8	5.1± 1.6	4.8± 1.3	.004 BD < 3m**
Limited activity due to decreased food consumption						
	14.6± 4.4	15.4± 4.5	14.5± 4.4	13.7± 4.7	13.2± 4.7	.001 2w > 3m*, 2w > 6m**
Passage dysfunction immediately after eating						
	12.0± 4.9	13.0± 4.2	12.3± 3.7	12.1± 4.3	11.3± 3.2	.007 2w > 6m**
Diarrhea-like symptoms						
	3.9± 2.0	4.1± 2.1	3.9± 2.1	4.3± 2.1	4.2± 2.1	.364

Abbreviations : DAUGS, Dysfunction After Upper Gastrointestinal Surgery ; BD, before discharge ; 2w, 2 weeks postoperative ; 6w, 6 weeks postoperative ; 3m, 3 months postoperative ; 6m, 6 months postoperative.

Scores are presented as mean (\pm standard deviation).

* $p < .05$, ** $p < .01$: at post hoc Bonferroni test.

regurgitation/reflux ; 0.66-0.77, limited activity due to decreased food consumption ; 0.61-0.81, passage dysfunction immediately after eating ; 0.67-0.80, dumping-like symptoms ; 0.45-0.76, transfer dysfunction/deglutition disturbance ; 0.48-0.73, hypoglycemic symptoms ; 0.43-0.55, and diarrhea-like symptoms ; 0.81-0.92. Of the five surveys, dumping-like symptoms, transfer dysfunction/deglutition disturbance, and hypoglycemia symptoms, which had Cronbach's alpha coefficient of 3 or more or less than 0.7, were excluded from the analysis because of inadequate reliability.

The total score was the highest at 2 weeks. The score fell thereafter, and that at 6 months was significantly lower than at 2 weeks ($p < .05$). In the subscales, we observed changes different from the change in the total score. On the subscales "limited activity due to decreased food consumption," and "passage dysfunction immediately after eating," scores deteriorated temporarily at 2 weeks like the total score, but decreased gradually thereafter, which meant that symptoms had alleviated ($p = .001$, $.007$, respectively). There were no significant changes in the

scores of "diarrhea-like symptoms." The score on "regurgitation/reflux" increased with time ; compared to before discharge, the scores at 3 months deteriorated significantly ($p < .01$), and the symptoms were apparent in a more intense manner.

We examined the relationships between DAUGS total and the responses on the eating behavior-survey. There were no significant correlations at any time point.

4. Mental state (depression)

Regarding participants' depressive state, the tendency towards depression in terms of CES-D scores is shown in Table 3. Across all participants, depression scores rose at 2 weeks, reaching maximum points and passed higher score than before discharge. The scores decreased thereafter to a level lower than before discharge, but there were no significant differences in the change over time ($p = .093$). We investigated the changes in the CES-D scores of each group by dividing the CES-D scores before discharge into the low depression group (< 16) and high depression group (≥ 16). There were no significant

Table 3 CES-D scores according to depression levels of those in low and high grades

	Before discharge	2 weeks	6 weeks	3 months	6 months	<i>p</i> -value
All participants (n=64)	11.6±8.3	12.5± 8.9	10.7± 8.0	10.4±7.4	9.9±6.1	.093
Difference of CES-D scores by depression						
Low (CES-D < 16, n=50)	8.0±4.2	9.9± 6.1	8.7± 4.9	9.3±6.7	9.5±6.2	.331
High (CES-D ≥16, n=14)	24.4±6.3	21.9±11.0	17.6±12.5	14.5±8.4	11.1±6.1	.000 BD > 3m*, BD > 6m**, 2w > 6m**
Ratio of High depression	14/64	14/64	10/64	11/64	7/64	.439

Abbreviations: CES-D, the Center for Epidemiologic Studies Depression ; BD, before discharge ; 2w, 2 weeks postoperative ; 3m, 3 months postoperative ; 6m, 6 months postoperative.

Scores are presented as mean ± standard deviation.

p* < .05, *p* < .01 at post hoc Bonferroni test.

Table 4 Correlations between CES-D scores and DAUGS total scores

	<i>r</i>	CES-D Total Score				
		Before discharge	2 weeks	6 weeks	3 months	6 months
DAUGS Total Score		0.450**	0.515**	0.404**	0.312*	0.397**

Abbreviations: CES-D, the Center for Epidemiologic Studies Depression ; DAUGS, Dysfunction After Upper Gastrointestinal Surgery.

r : Pearson's correlation coefficient.

p* < .05, *p* < .01

differences between the groups with respect to patient characteristics or gastric cancer-related factors (precise data were not shown). The low depression group had the highest CES-D score at 2 weeks, but there was no significant change over time. The score before discharge of the high depression group was the highest at 24.4 (*SD* 6.3) and decreased significantly at 6 months (*p* < .001), almost to the same level as that of the low depression group. The high-depression group had significantly higher scores than the low-depression group from before discharge to 3 months (*p* = .000–.022).

The CES-D score by gender, age (≥ 65 years old), living with family, employment status, gastrectomy type, cancer stage, and adjuvant chemotherapy at each time point was examined. The score of the total gastrectomy group was 16.8 (*SD* 9.0) at 2 weeks, which was significantly higher than that of the subtotal gastrectomy

group, 11.2 (*SD* 8.5) (*p* = .031). Other factors did not influence on the CES-D scores. We investigated the correlation between the DAUGS and CES-D scores to assess the relationship between post-gastrectomy dysfunction and depression symptoms (Table 4). There were positive correlations at each point of assessment, and was a slightly stronger positive correlation at 2 weeks.

5. Factors associated with post-gastrectomy dysfunction

We examined difference of DAUGS scores by attributes, cancer-related factors, and depression levels of the participants ; significant differences are shown in Table 5. We found interactions between the factors of cancer stage and time. We also found significant changes during the 6 months following surgery in age, gender, and gastrectomy type, but no significant differences within each group. There were no significant

Table 5 Difference in DAUGS scores by factors following up to 6 months

	n	Before discharge	2 weeks	6 weeks	3 months	6 months	Main effect of		Time-by-factors interaction			
							time	F-value	p-value	F-value	p-value	
Age												
<65 years old	24	56.7 ± 12.3	57.8 ± 12.4	54.3 ± 11.8	54.4 ± 12.8	53.0 ± 12.4	2.866	.024	2.144	.148	1.523	.196
≥65 years old	40	49.0 ± 12.5	53.4 ± 13.4	53.3 ± 14.3	51.4 ± 12.9	48.7 ± 11.4						
Gender												
Male	40	52.8 ± 15.0	55.4 ± 14.9	55.3 ± 14.9	53.5 ± 14.2	51.3 ± 12.8	3.246	.013	0.846	.361	0.356	.840
Female	24	50.2 ± 8.1	54.6 ± 9.5	51.0 ± 10.0	51.0 ± 10.6	48.7 ± 10.2						
Living with others												
Yes	54	52.3 ± 13.2	55.3 ± 13.0	55.0 ± 13.8	53.7 ± 13.1	50.7 ± 11.9	2.105	.081	1.418	.238	1.280	.278
No	10	49.5 ± 11.1	53.9 ± 14.3	46.8 ± 7.6	46.5 ± 10.2	48.4 ± 11.9						
Employed												
Yes	29	56.8 ± 15.2	58.2 ± 13.4	55.8 ± 12.9	55.3 ± 13.2	53.3 ± 14.2	3.180	.014	5.010	.029	0.934	.445
No	35	47.8 ± 8.9	52.5 ± 12.4	52.0 ± 13.6	50.1 ± 12.2	47.8 ± 9.0						
Gastrectomy type												
Total gastrectomy	15	55.3 ± 18.8	58.5 ± 16.5	58.9 ± 14.0	60.3 ± 14.2	54.5 ± 12.6	2.514	.042	3.921	.052	0.684	.604
Subtotal gastrectomy	49	50.8 ± 10.5	54.0 ± 11.8	52.1 ± 12.8	50.3 ± 11.7	49.0 ± 11.5						
Cancer stage												
I	53	51.9 ± 11.8	55.4 ± 12.5	53.5 ± 13.4	51.3 ± 11.9	48.9 ± 10.6	0.937	.443	0.607	.439	3.024	.018
II-III	11	51.5 ± 17.9	53.6 ± 16.0	54.5 ± 13.4	58.2 ± 16.1	57.2 ± 15.6						
Adjuvant chemotherapy												
No	56	51.3 ± 11.8	54.6 ± 12.7	53.1 ± 13.2	51.2 ± 11.9	48.8 ± 10.3	0.639	.635	3.108	.083	1.570	.183
Yes	8	55.9 ± 19.4	58.5 ± 15.7	57.5 ± 14.1	61.3 ± 16.5	60.9 ± 16.9						
Depression level												
Low (CES-D < 16)	50	48.5 ± 10.0	51.5 ± 10.3	51.5 ± 13.0	49.7 ± 11.9	48.5 ± 10.8	4.456	.002	16.980	.000	2.287	.061
High (CES-D ≥ 16)	14	63.3 ± 15.1	67.9 ± 14.5	60.9 ± 12.3	60.7 ± 14.3	56.7 ± 13.7						

Abbreviations : DAUGS, Dysfunction After Upper Gastrointestinal Surgery ; CES-D, the Center for Epidemiologic Studies Depression ; 2w, 2 weeks postoperative ; 6m, 6 months postoperative.

Scores are presented as mean ± standard deviation.

* $p < .05$, ** $p < .01$, *** $p < .001$.

differences in living with others, cancer stage, or adjuvant chemotherapy. Being employed and depression levels showed significant changes and differences. In age, gender, and depression levels, DAUGS scores were significantly lower at 6 months versus 2 weeks ($p < .05$, $.01$, $.001$, respectively). The DAUGS scores of the employed group was significantly higher than of the other groups ($p = .005$) before discharge. In terms of depression levels, there were significant differences in DAUGS scores between the high and low depression groups at all time points of assessment. In the high depression group, the DAUGS scores decreased significantly from 67.9 (SD 14.5) at 2 weeks to 56.7 (SD 13.7) at 6 months ($p = .004$).

Discussion

This study was conducted with the aim to elucidate the eating behavior and physical/depressive state of post-gastrectomy patients 6 months after surgery, and the relationship between these variables.

1. Relationship between post-gastrectomy dysfunction and eating behaviors

Post-gastrectomy dysfunction in gastric cancer patients was evaluated using the DAUGS. Over 6 months, the total scores changed significantly. The scores increased immediately after discharge, then decreased during the following 6 months. In recent years, early discharge has been promoted; patients are thus discharged at a time corresponding to 2 weeks after surgery, which may correlate to difficulties adapting to an independent environment at home due to the protected situation during hospitalization. In a previous 1-year follow-up study of distal gastrectomy patients, symptoms and QOL during the first month were the worst and then improved over the next 6 months, showing similar results to ours²⁶. In spite of the fact that most patients had practiced eating slowly and adjusting their intake amount so as not to overeat at 2 weeks, post-

gastrectomy symptoms increased. In particular, "passage dysfunction immediately after eating" intensified 2 weeks after surgery, and this may be because the meal forms and chewing habits from prior to surgery do not match the form of the stomach or the decline in digestive function changed by surgery. As the number of days that gastrectomy patients stay in the hospital has shortened to 7-10 days after surgery, while meal intake starts in the hospital, patients are discharged before their meal intake habits have been adequately established. Although participants and their families received nutrition guidance from a dietitian or a nurse before discharge, there was a possibility that they did not acquire enough dietary methods for recovery. Therefore, it is necessary to strengthen support and continue it after early discharge from hospitalization.

Symptoms like regurgitation and diarrhea did not become less common, and in fact increased during the study period. Such post-gastrectomy dysfunction occurs primarily in relation to food intake, and tend to occur as the quantity of food intake increases without waiting for the digestive function of the stomach to recover. Therefore, it is necessary to focus on specific approaches such as chewing adequately and taking time to eat, dividing meals, and adjusting the quantity eaten. Postoperative dysfunction varies greatly depending on the gastrectomy type²⁷⁾²⁸. The total gastrectomy group did not increase their intake due to the remaining stomach capacity and their body weight also decreased, even though they practiced same eating behavior as the sub-total group. By telling patients in advance (prior to hospitalization) that such symptoms can occur, patients may be able to use this knowledge to integrate coping behaviors. We need to continuously observe progress and follow up in detail.

At 6 months, the number of patients who are capable of meal-coping behaviors, such as eating slowly and adjusting the quantity eaten to avoid being full, decreased; thus, it may be difficult to restrict food quantity over long periods or

increase the number of meals once a patient has returned to typical life. However, there was no statistical relationship between post-gastrectomy symptoms or patient factors and eating behaviors. Because this is a subjective topic, it may have been insufficient to have participants evaluate whether or not their eating behaviors are appropriate for their symptoms. In the future, it will be necessary to evaluate eating behaviors objectively such as with quantitative measurement of meal times and intake or incorporating nutritional guidance and the patients' understanding of nutrition.

2. Relationship between physical and mental state

We evaluated the extent of depression (CES-D) as a representation of participants' mental state and an influencing factor for their performance of self-care. When considering all participants, there were no significant changes of CES-D scores over 6 months after surgery. Hong et al. (2014) reported that depression levels were high among Chinese cancer patients compared with the general population²⁹⁾. The CES-D mean score in our study exceeded the mean value of 8.9 (*SD* 7.1) of the healthy control group in an investigation by Shima et al. (1985)²³⁾, which suggests that there is an influence of gastric cancer surgery on the mental state of patients. At every assessment time point, there was a positive correlation between post-gastrectomy dysfunction and depression. In addition, the high depression group before discharge had worse post-gastrectomy dysfunction for 6 months than did the low depression group. We did not investigate patients' depressive state before surgery. Although we cannot determine the cause of such depression in our survey, we can see that emotional stress and depression were related to digestive diseases and post-gastrectomy symptoms¹⁸⁾³⁰⁾, suggesting a close relationship between physical and mental states. Since this was a survey that was conducted up until 6 months post-gastrectomy, there was no

difference in the CES-D score with the exception of the gastrectomy type, but over longer periods of time, this score may be influenced by chemotherapy and the progression of cancer.

When participants were divided according to their CES-D scores before discharge, the high-depression group had a high score before being discharged, but there was a significant decrease after that, down to the point where there was no difference compared with the low-depression group at 6 months. There were no differences between the two groups in terms of participant attributes or gastric cancer information, and we were unable to elucidate the elements that led to higher depression scores at the time before discharge. Since the assessments started immediately after patients underwent surgery, there may have been patients showing depression symptoms after a strong influence of post-surgical pain, decline in body strength, and post-discharge anxiety, as well as patients who were only slightly affected by it. It has been reported that preoperative depression, complications, and younger age increase the risk of postoperative mental state³¹⁾. Regardless of the timing of the investigation, we believe that there is a correlation between depression and post-gastrectomy dysfunction, and that it is necessary to offer postoperative support by keeping in mind that psychological and physical aspects of health are deeply related.

At present, many Japanese gastric cancer patients have hospital visits after being diagnosed with the condition in a health check-up. Given that patients receive explanations about tests, diagnosis, and surgery when they visit the hospital, it is very difficult to assess the mental state excluding the effect of these factors. The future goal, therefore, is to consider assessing patients before and after surgery to understand patients' predisposition to depression and intervene at an early stage.

It has been reported that gastric cancer patients at any stage who suffer from emotional distress have worse outcomes²⁰⁾, even those with

early gastric cancer can suffer emotional distress, which may lead to poorer outcomes. In this study, post-gastrectomy dysfunction of the high-depression group was severer than it of the low-depression group continuously for 6 months. In order to alleviate physical symptoms, it may be necessary to provide continuous emotional support in parallel.

3. Support for post-gastrectomy patients

In this study, post-gastrectomy dysfunction was significantly worse at 2 weeks than before discharge, which was immediately after surgery. We posit that patients had difficulties adapting due to the environment change after being discharged from the hospital, inadequate meal intake levels, and the experience of unhealed wounds or wound pain due to shortened hospitalization times. It is necessary to inform patients of the possibility that symptoms can deteriorate compared to when they were hospitalized, and provide them with measures that can be taken in response. In particular, as high-depression patients showed worse physical symptoms than the low-depression group up to 6 months after surgery, we believe that strengthening the support during this time for patients with a tendency to depression would help alleviate physical symptoms and that regular interventions would be necessary.

In general, post-gastrectomy patients have their first outpatient visit around 2 weeks after being discharged and another visit before 6 weeks after surgery to decide whether or not to receive postoperative adjuvant chemotherapy. It would be ideal if support could be provided effectively in these two times outpatient visits, but the reality is that outpatient medical examinations performed by physicians fall short of providing adequate support for daily life. In recent years, there has been an increase in the use of online interactive medical diagnostics and services, as well as attempts at supportive interventions for patients through social networking services (SNS) or

smartphone applications^{32)–34)}. Therefore, it has become possible to communicate with healthcare professionals even remotely, helping patients to understand and manage their condition; support based on tools that healthcare professionals and patients can use interactively will be an effective approach in the future.

The following study limitations are noted. The sample size was relatively small, and all participants were recruited from only three facilities in Japan; therefore, the generalizability of the findings might be limited. The participants included eight postoperative adjuvant chemotherapy patients. All were treated with oral chemotherapy (S-1) and the study included those who were able to continue chemotherapy without any side effects as well as those who discontinued it due to severe side effects. The symptoms of side effects of chemotherapy are similar to those seen in post-gastrectomy dysfunction, including nausea and appetite loss, so it is difficult to determine which effects were due to which treatment. Therefore, we believe that it will be necessary to examine individuals separately in the future. Because post-gastrectomy dysfunction was an endpoint in this study, data collection began after surgery. However, regarding depressive tendencies as an indicator of mental status, we need to consider the effect that cancer diagnosis, hospitalization, and surgery may have on depression. We were unable to determine whether depression was preexisting or developed postoperatively because we lacked pre-operative data. Further data needs to be gathered, and we believe that a follow-up survey over 1 year will produce more accurate results.

Conclusions

Patients undergo various changes in their physical and depressive states during the first 6 months after gastrectomy. Post-gastrectomy dysfunction worsened immediately after discharge and was alleviated over 6 months. In addition, patients in the high depression group

continued to experience more severe post-gastrectomy dysfunction compared to patients in the low depression group, and a relationship between physical and mental states was observed. While depression tends to improve over time, medical staff should understand patients' depressive state during hospitalization and continue to observe the post-gastrectomy dysfunction early postoperative period. We plan to examine the relationship between self-care abilities and mental and physical conditions in the future.

Conflict of Interest

The authors have no conflict to declare.

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胃切除後6ヶ月間における胃癌患者の食行動および、 身体的・精神的状態の変化

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【目的】胃切除術を受けた胃癌患者の術後半年間における食行動, 身体的状態およびうつ傾向の実態とそれらの関連を明らかにすることである。

【方法】胃癌で胃切除術を受けた患者を対象に, 食行動, 術後機能障害 (DAUGS), 抑うつ (CES-D) に関する質問紙調査を, 術後半年の間に5回 (退院前, 術後2週間, 6週間, 3ヶ月, 6ヶ月) 縦断的に実施した。各項目の経時的変化は反復測定分散分析を用い, 患者要因と術後機能障害の関連は二元配置分散分析を用いて検討した。抑うつと術後機能障害の関連は, 相関関係を用いて分析した。

【結果】64名の胃切除術後患者を対象とした。平均年齢66.5 (SD10.3) 歳, 男性40名であった。幽門側胃切除術46名で, 胃癌ステージIが53名であった。体重は術後半年間で約10%減少した ($p < .001$)。術後半年経つと, 食事量調整などの食行動を実践している人は8割から全体の半数に減少したが, 食事摂取量は術前の8割程度に回復した。術後機能障害 (DAUGS) は術後2週間が最も強く, その後半年間で有意に改善した ($p < .05$)。患者要因による DAUGS 得点の推移を見ると, 就労群と高抑うつ群の機能がより障害されていた。高抑うつ群の術後機能障害の程度は, 低抑うつ群と比べ, 6か月間を通じて重かった。

【結論】胃切除後の機能障害は退院直後が最も悪く, 6ヶ月間で軽快し, 身体的状態と抑うつ状態が関係していることが明らかになった。医療者は, 入院中から患者の抑うつ状態を把握し, 術後早期からの胃切除術後機能障害の継続的な観察を行う必要がある。

キーワード: 胃癌, 胃切除術後機能障害, 抑うつ, 食行動, 縦断研究