ORIGINAL PAPER

Nagoya J. Med. Sci. **74**. 241 ~ 251, 2012

POSTOPERATIVE FUNCTION FOLLOWING RADICAL SURGERY IN GASTRIC AND COLORECTAL CANCER PATIENTS OVER 80 YEARS OF AGE –AN OBJECTION TO "AGEISM"–

SHINJI FUKATA[1], MASAHIKO ANDO[2], TAKESHI AMEMIYA[3], KOJIRO KUROIWA[4] and KOJI ODA[5]

[1]*Department of Perioperative Medical Care, National Center for Geriatrics and Gerontology, Obu, Japan*
[2]*Health and Medical Services, Kyoto University Graduate School of Medicine, Kyoto, Japan*
[3]*Department of Surgery, Anjo Kosei Hospital, Anjo, Japan*
[4]*Department of Surgery, Tokyo Metropolitan Geriatric Hospital, Tokyo, Japan*
[5]*Department of Breast Oncology, Aichi Cancer Center Aichi Hospital, Okazaki, Japan*

ABSTRACT

PURPOSE: With rapid growth in the elderly population, the number of elderly cancer patients who should be offered life-prolonging radical surgery has been increasing. The aim of this report is to demonstrate the outcome of elective radical surgery for gastric or colorectal cancer patients 80 years of age or older, including the natural course of recovery of functional independence, in order to avoid the negative attitude held toward surgery that is due only to patients' high chronological age.
METHODS: Physical condition, ADL, and QOL of 108 patients 80 years of age or older with gastric or colorectal cancer were evaluated preoperatively and at the 1st, 3rd, and 6th postoperative months.
RESULTS: There were no operative deaths, and the morbidity rate was 27.9%. Only 6% of the patients showed a decrease in ADL at the 6th postoperative month. This decrease typically occurred following discharge from the hospital. Patient QOL showed recovery to an extent equal to or better than average preoperative scores.
CONCLUSIONS: Of the patients who underwent elective surgery for gastric or colorectal cancer, only a few showed a protracted decline in ADL, and most exhibited better QOL after surgery. Surgical treatment should therefore be considered, whenever needed, for elderly patients 80 years of age or older with gastric or colorectal cancer.

Key Words: Activities of Daily Living (ADL), Quality of Life (QOL),
Mini-Mental State Examination (MMSE), Gastric cancer, Colorectal cancer

INTRODUCTION

In 2010, Japanese citizens who were 80 years of age were expected to live on average an additional 12 years (for females) and 9 years (for males). Furthermore, that same year, 85-year-old women and men were likely to live an additional 8 and 6 years, respectively.[1)] With rapid growth

Received: January 19, 2012; accepted: March 6, 2012

Corresponding author: Shinji Fukata, MD, PhD

Department of Perioperative Medical Care, National Center Hospital for Geriatrics and Gerontology, 36-3 Gengo, Morioka, Obu, Aichi 474-8511, Japan.

Phone: +81-(0)562-46-2311, Fax: +81-(0)562-48-2373, E-mail: fukatash@ncgg.go.jp

in the population of the elderly who have more than 5 years life expectancy, the number of cancer patients 80 years of age or older who should be offered life-prolonging radical surgeries has been increasing.

It is generally believed that surgical procedures considered standard treatment for a particular disease in younger individuals are sometimes inappropriate in elderly patients, especially those with co-morbidities; i.e., patients treated by surgery may recover from the disease itself but become so disabled that they are bedridden for the remainder of their lives.[2] Elderly patients often have multiple needs if they become disabled following surgery (e.g., social, psychological, and economic, in addition to rehabilitative and nursing), and medical and surgical problems affecting elderly patients cover multiple fields and require a coordinated treatment approach among the professionals involved. This is the reason why postoperative assessment of activities of daily living (ADL) is a very important additional measure for the successful outcome of surgical treatment for the elderly.

We previously reported that elected radical surgery for gastric and colorectal cancer can be performed safely in elderly patients 75 years of age or older.[3] In our study, only a few patients showed a protracted decline in ADL. Most, in fact, exhibited a better quality of life (QOL) after surgery.

The aim of this report is to demonstrate the outcome of elective radical surgery for gastric or colorectal cancer in patients 80 years of age or older, including the natural course of recovery to functional independence. This will be useful information for elderly cancer patients, their families, and their physicians in deciding whether or not to proceed with radical surgery. Favorable evidence and results may also help combat "ageism," a negative attitude toward surgery in elderly patients due only to their chronological age, which currently exists among patients, their families, and the medical community.[4, 5]

METHODS

One hundred and eight patients, all 80 years of age or older, were selected from among the 232 eligible patients in our previous study,[3] all of whom had gastric or colorectal cancer and were 75 years of age or older. Patients in the previous study were referred to the surgical departments in 29 affiliated hospitals between June 2003 and September 2004, and were enrolled consecutively in the study. All patients underwent surgical resection of gastric or colorectal cancer in those hospitals.

Physical status, operative severity, morbidity, and mortality

The parameters examined were physical status, operative severity, and morbidity. They were measured by assessing the Physiological and Operative Severity Score for enUmeration of Mortality and Morbidity (POSSUM)[6] and the Estimation of Physical Ability and Surgical Stress (E-PASS) score.[7] The severity of each co-morbidity and postoperative complication was categorized from Grade 1 to Grade 4 using the National Cancer Institute-Common Toxicity Criteria (NCI-CTC) v2.0.[8] Postoperative complications of Grades 3 and 4 were defined as major complications. Outcomes in all patients as of April 1, 2005, 6 months after entry of the last patient into the study, were examined, and a mortality rate for the entire patient population was calculated.

Activities of daily living

Functional dependence in basic ADL was evaluated using the Katz Index.[9] The need for

supervision, direction, personal assistance, or total care for any dependent function of the Katz Index was also recorded in order to assess minute declines or increments in patients' ADL.[10] In addition to the Katz Index, the following functions were also evaluated: ability to maintain a sitting position in bed (impossible, able to sit with Gatch support, able to sit without Gatch support); ability to sit down on a chair or stool from a standing position (bedridden, unable to sit down on a chair, able to sit down on a chair, able to sit on a chair or stool without back support); ability to maintain a standing posture (impossible, possible with both hands held, possible with one hand held, possible unassisted); and ability to walk on a level surface or, if unable to walk, to move in a wheelchair (impossible, able to use a wheelchair with help, able to propel a wheelchair independently, able to walk with help, able to walk independently).[3]

Quality of life

QOL was evaluated using the SF-12 and EuroQoL 5-D (EQ5D). The SF-12 is a set of twelve generic, coherent, and easily administered QOL questions, the answers to which produce two summary measures of the patient's physical and mental aspects of health.[11] The EQ5D is a short, 5-item, patient-completed measure of health status in terms of mobility, self care, usual activities, pain or discomfort, and anxiety or depression; the values are then used to produce a combined single index score that ranges from –0.111 (worse than death) to 1.000 (perfect health).[12]

Additional evaluations

Additional evaluations included the Folstein Mini-Mental State Examination (MMSE).[13,14]

Data collection

The participants' attending physicians made physical assessments and recorded operative severity using their operative records. Physical conditions and QOL were assessed at the time of admission to the surgical department, and 3 times postoperatively, at 1, 3, and 6 months, respectively. ADL evaluations were performed at the time of admission and 4 times postoperatively, at 7 to 10 days, and 1, 3, and 6 months, by a researcher at each institute who had taken a training course for this prospective study beforehand. In some cases, data collection at 1 month was replaced by data at the time of discharge (Fig. 1). When patients were referred to other hospitals postoperatively, their attending physicians at the new hospitals were interviewed by telephone. At the end of the study, we assessed the patients for interim health events that would potentially modify the course of recovery, such as fractures, other significant operations, and cerebrovascular accidents.

Statistical analysis

To identify the risk factors for a decline in ADL after surgery, the odds ratios for postoperative decline were calculated using a Generalized Estimating Equations (GEE) model.[15] To make a direct comparison between the odds ratios of surgical scores (POSSUM and E-PASS), these scores were transformed linearly, ranging from 0 (best score) to 10 (worst score) before inclusion into two separate GEE model calculations. In addition to the surgical scores, age, gender, cancer site (stomach or colorectum), pathological stage, and MMSE score were included. We then examined whether these variables correlated significantly with postoperative ADL decline. A –2 log-likelihood value for fitting the model with all the explanatory variables was separately calculated for the POSSUM and E-PASS GEE models, allowing us to compare their performance. The adjusted means of QOL scores were calculated preoperatively, and 1, 3, and 6 months after surgery using the MIXED procedure with the repeated statement. All statistical analyses were performed by SAS Version 9 software (SAS Institute, Cary, NC).

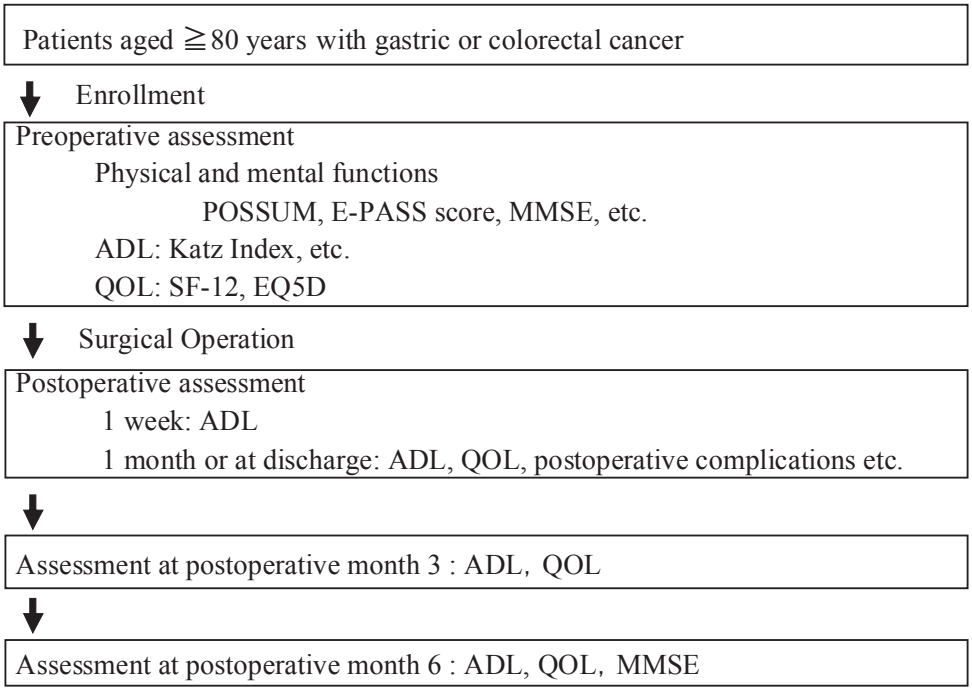

Fig. 1 Study design

Ethical and humane considerations

This study was approved by the institutional Review Board of the National Center for Geriatrics and Gerontology and all participating hospitals, and all participants gave their written informed consent.

RESULTS

Patient recruitment and follow-up

An outline of patient recruitment and follow-up is shown in Figure 2.

Baseline characteristics

The study population consisted of 54 men and 54 women. Their ages ranged from 80 to 92 years, with a mean of 83.7±3.2; 71 patients were 80 to 84 years of age and 37 patients were 85 years of age or older. The mean heights of the female and male patients were 144±5.9 and 159±7.1 cm, respectively. The Body Mass Index (BMI) values for the female and male patients were 21.3±3.2 and 21.0±3.8 kg/m^2, respectively. There were 6 female and 4 male patients with BMI ≥ 25.0 kg/m^2 (1 patient each with BMI ≥ 30 kg/m^2). In the preoperative assessments, 82.0% of the patients scored A, B or C in the Katz index, and 76.0% of the patients scored 0 or 1 in their performance status. The MMSE scores of the patients were as follows: 25–30, 64.8% (68/105); 21–24, 22.0% (23/105); and ≤20, 13.3% (14/105). 35.2% (≤ 24 in the MMES scores) of the patients had presumptive evidence of cognitive problems or dementia. The baseline characteristics of the participants are shown in Table 1. There were 47 patients with gastric

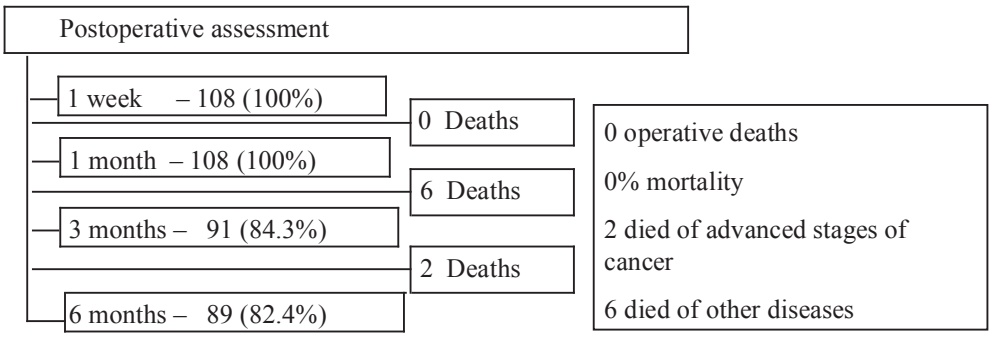

Fig. 2 Postoperative Assessment and mortality

Table 1 Baseline characteristics of participants

Gender, n	
M/F	54/54
Age	
mean±SD (range), years	83.7±3.2 (80 – 92)
80–84/85 – , n	71/37
Height, mean±SD, cm	
M/F	159±7.1/144±5.9
BMI, mean±SD, kg/m^2	
M/F	21.0±3.8 /21.3±3.2
≧25.0 (≧30), M/F, n	4/6 (1/1)
Katz Index [a], no	
A/B/C/D/E/F/G/Other	72/11/7/5/6/3/3/1
Performance Status [b], n	
0/1/2/3/4	44/38/16/9/1
MMSE, n	
25–30/21–24/≦20	68/23/14
	(Three patients were excluded from this examination)

a) Katz Index ranks adequacy of performance in the six functions of *bathing*, *dressing*, *toileting*, *transferring*, *continence*, *and feeding*. A: Independent in feeding, continence, transferring, toileting, dressing, and bathing. B: Independent in all but one of those functions. C: Independent in all but bathing and one additional function. D: Independent in all but bathing, dressing and one additional function. E: Independent in all but bathing, dressing, toileting, and one additional function. F: Independent in all but bathing, dressing, toileting, transferring, and one additional function. G: Dependent in all six functions.

b) Performance status index defined by the Japanese Society for Cancer Therapy,[24] the same as defined by the Eastern Cooperative Oncology Group[25]; 0: asymptomatic; 1: symptomatic but completely ambulatory; 2: symptomatic, <50% in bed during the day,; 3: symptomatic, >50% in bed, but not bedridden; 4: bedridden; 5: dead.

cancer and 61 patients with colorectal cancer. Their pathological cancer stages and operative procedures are summarized in Table 2.

Table 2 Stage and operation

	Gastric cancer	Colorectal cancer
Stage		
0	0	0
I	24	8
II	6	20
II	14	29
IV	3	4
Lymphadenectomy [26,27]		
D0	2	1
D1	27	10
D2	17	25
D3	1	25
Remnant tumor [28]		
R0, R1	45	58
R2	2	3

Preoperative complications

Twenty-seven patients (25%) had preoperative cardiac complications (ischemic heart disease, 17 cases; arrhythmia, 7 cases; heart failure, 2 cases; and valve disease, 1 case). Other preoperative complications included hypertension (40 cases), diabetes mellitus (14 cases), and cerebral vascular ischemia (11 cases).

Mortality and morbidity

There were 8 deaths by 6 months after surgery. Of those 8 patients, 2 died of advanced stages of cancer (gastric cancer, n=1; colorectal cancer, n=1). Six patients died of other diseases (pneumonia (n=3), cardiac failure (n=1), and unknown causes (n=2)). Two of these patients died of postoperative complications in the hospital (cardiac failure and pneumonia, n=1 for each). There were no operative deaths. Thirty patients (27.9%) had major postoperative complications; delirium was the most frequent (12%), followed by respiratory failure (7%), anastomotic leakage (3%), surgical site infection (3%), and pneumonia (3%).

ADL

Twenty-nine percent of the patients had a Katz Index score during the first postoperative month that was lower than the preoperative level (Fig. 3). However, most patients recovered from this transient reduction in ADL. The percentage of patients showing a decline at POM (postoperative month) 6, measured by the Katz Index alone, was 6% (Fig. 3). The number of patients, however, who showed declines in any function evaluated at POM 6 was 12 (11%). Of these 12 patients, 11 did not have any complications or accidental events during the first 6 postoperative months, although one patient had cerebral hemorrhage. The patient with cerebral hemorrhage, however, was not included in the 6% of patients who showed a decline in function at POM 6 by the Katz Index alone.

There were 3 representative declining patterns in the postoperative course of ADL. In pattern A, the ADL deteriorated immediately after surgery and remained low (or had some recovery

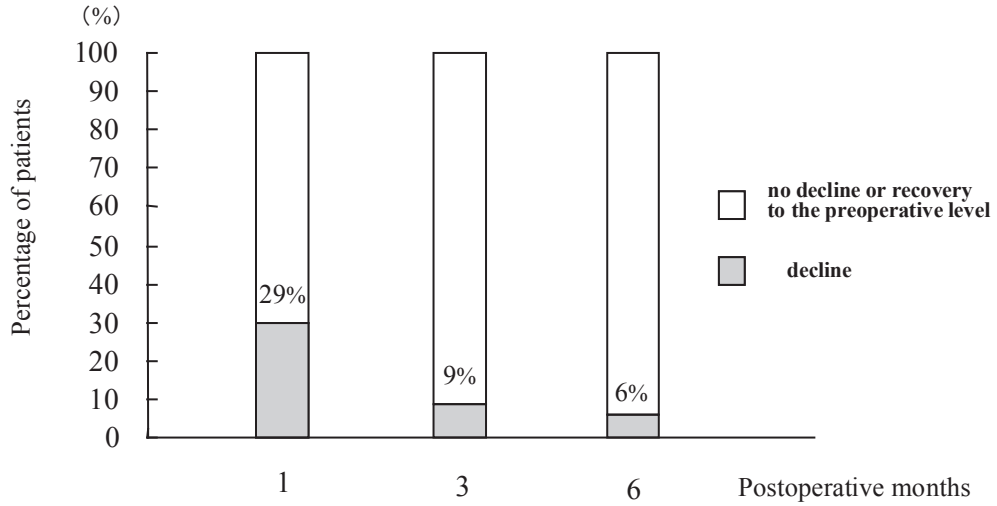

Fig. 3 Postoperative change in ADL (Katz Index)

Table 3 Predictive value of clinical factors for protracted decline in ADL: Results of GEE analyses

	POSSUM model			E-PASS model		
Variables	Odds Ratio	95% CI	P value	Odds Ratio	95% CI	P value
Surgical Score*	1.1	0.87–1.37	0.44	1.1	0.87–1.31	0.51
Age	1.1	0.98–1.25	0.09	1.1	0.97–1.25	0.12
Male	1.3	0.60–2.88	0.49	1.3	0.60–2.67	0.54
Colon Cancer**	1.3	0.62–2.67	0.49	1.2	0.61–2.45	0.56
MMSE	0.9	0.83–0.99	0.02	0.9	0.82–1.01	0.08
Pathological Stage	1.2	0.75–1.77	0.50	1.2	0.79–1.82	0.39
–2 Log-Likelihood		215.6			215.6	

* POSSUM and E-PASS CRS scores were included in two separate GEE model calculations
** Colon Cancer/Gastric Cancer

but did not reach the preoperative level). In pattern B, the ADL fell immediately after surgery, recovered completely or almost completely to the preoperative level briefly, and was followed by a second decline after discharge from the hospital. In pattern C, the ADL did not decrease until discharge from the hospital. The proportions of patients showing patterns A, B, and C were 6%, 33%, and 61%, respectively. Overall, the ADL of elderly patients who showed declines in any function evaluated at POM 6 were likely to decrease after discharge from the hospital, regardless of whether they had a brief recovery from the initial drop or no decline at all during their hospital stay.

In comparing the two surgical scores, the –2 log-likelihood value with all the explanatory variables was 215.6 both for the POSSUM and E-PASS GEE models (Table 3). Among the other variables, the MMSE score correlated significantly with postoperative ADL declines in the POSSUM model. Parameters such as pathological stage, cancer site, age, gender, and presence of postoperative complications did not show significant correlation with postoperative ADL decline.

QOL

The mean scores of the Physical Components Summary (PCS) and Mental Components Summary (MCS) of the SF-12 fell immediately after surgery, but recovered from a temporary decline to the preoperative level, or became even higher, in POM 3 to 6.

The average QOL scores of EQ5D measured before, immediately after, 3 months after, and 6 months after operation were 0.751, 0.751, 0.775, and 0.804, respectively. The average EQ5D score was significantly higher than the preoperative level at POM 6 ($P<0.005$).

DISCUSSION

In our previous study of patients 75 years of age or older, we determined that elderly patients frequently showed a transient decrease in ADL immediately after surgery. However, the ADL of most patients recovered after the transient postoperative decline, and there was no difference in the postoperative long-term ADL between patients with or without temporary postoperative disability. The number of patients showing declines in any ADL parameter at POM 6 was 21 (11%).[3)]

In the group of patients 80 years of age or older, the frequency of the transient decrease in ADL immediately following surgery was higher than in the 75-year-old-or-older group, but the frequency of decline in any ADL parameter at POM 6 was the same, 11%. These findings indicate that even when patients are 80 years of age or older, it is unlikely that they will develop a mid- to long-term decrease in ADL once they survive the perioperative period. The frequency of major postoperative complications was also almost the same in both patient groups, although the frequency of delirium was higher in the 80 or older group.

In both groups, most late-developing disabilities occurred after a transient recovery of certain aspects of function, sometimes during the follow-up period after discharge from the hospital. Since only 1 of the 12 patients showing protracted disability in the older group had complications or accidental events after discharge, lifestyle, lack of exercise, or less effective physical rehabilitation at home may be the major causes of their late decline in ADL.

In patients 75 years of age or older, age, gender, cancer stage, and increased POSSUM and E-PASS surgical scores were all significant risk factors for postoperative decline of Katz ADL Index.[3)] In patients 80 years of age or older, however, these significant prognostic factors did not show any correlation with postoperative ADL decline. In patients 75–79 years of age, cancer stage and increased POSSUM and E-PASS surgical scores were significant risk factors for postoperative decline of Katz ADL Index; odds ratios of the cancer stage in the E-PASS model, POSSUM surgical scores and E-PASS surgical scores were 1.85 ($P=0.004$), 1.21 ($P=0.024$), and 1.48 ($P<0.001$) respectively. It is considered that cancer stage and increased surgical scores, which are important factors for postoperative ADL decline in patients less than 79 years of age, do not need to be considered as much when patients exceed 80 years of age. In patients 80 years of age or older, correlation of age was not statistically significant, either. Deflection in age distribution (80–84 years / ≥85:71/37) may have been responsible for this result.

The MMSE score was the only prognostic predictor of protracted ADL decline. As for the patterns of ADL decline, ADL deteriorated after discharge from the hospital more frequently in patients 80 years of age or older (patterns A, B, and C were 6%, 33%, and 61%, respectively) than in patients 75–79 years of age (patterns A, B, and C were 14%, 46%, and 40%, respectively). Lack of exercise among elderly patients with low MMSE scores resulted from too much help available at home or in nursing facilities, and might have accelerated the decrease in ADL. This may indicate that postoperative patients 80 or older who show a low MMSE score

preoperatively may be good candidates for more active and intensive rehabilitation support, including exercise at home, at outpatient clinics, or in nursing homes, to restore and stimulate their function after discharge.[18,19)]

Patients with advanced gastric or colorectal cancer can only be cured, or expect 5 years survival, by radical surgery, and an improvement in the post-surgery survival rate has been reported in recent years.[18-21)] Radical surgery was performed for 45 (96%) of gastric and 58 (95%) of colorectal cancer patients in the present study. Our results, showed no mortalities, confirming that radical surgery for gastric or colorectal cancer rarely results in death, even for elderly patients 80 or older. In addition, our data show that by POM 6, radical surgery is unlikely to decrease ADL, and is likely to improve QOL in most patients 80 years of age or older with gastric or colorectal cancer, as well as in the overall patient group 75 or older. This then indicates that patients 80 or older who are medically fit before surgery have little more risk than younger patients, and implies that other major gastroenterological surgeries accompanied by similar surgical stress can be applied to the elderly.

The results of the present study are evidence against "ageism" attitudes held by some medical professionals, and should encourage elderly patients and their families to accept radical surgical treatment for gastric or colorectal cancers.[4, 5)]

There are some notable limitations to our study. Most of the participants had been referred to the surgery department for operation; and because the patients were advanced in age, physicians may have hesitated about referring them to surgery. A family doctor may look at the patient's state without conducting gastrointestinal investigations even if there are various symptoms, because of the patient's advanced age and poor general health condition. A study initiating at an early stage of the diagnosis may be necessary to reduce such a selection bias. Nevertheless, this study will be effective for determining the operative indication for doctors, patients, and their families referred to surgery at a point in time

This is a prospective study of the postoperative function of elderly patients after radical surgery for gastric and colorectal cancers in Japan. The patients were sequentially recruited and enrolled in the study from 29 different institutions; however, there were some characteristics of the study population that may reflect a silent selection process or geographical characteristics. The patients were of a shorter stature and their BMI measurements were mostly lower than the normal range of patients in the USA.[22)] It was reported in a recent epidemiological study that patients who are obese face a much higher likelihood of very serious problems following surgery.[23)] Although increased BMI was not a risk factor for mobility problems or protracted ADL decline in patients in either the 80 or older subset or the overall 75-year-old-or-older patient group (data not shown), it might be interesting and necessary to conduct a study of the same design in Western industrialized countries to answer the following question: "Should surgical treatment be offered to elderly patients 80 years of age or older with gastric or colorectal cancer, if the patient is not necessarily of short stature and/or low in BMI?" In these countries, the height and BMI of the same age population are expected to be higher than in Japan. Furthermore, our results may be a rationale for promoting patient education to avoid obesity in Japan and Western industrial countries as well.

CONFLICT OF INTEREST STATEMENT

Shinji Fukata and the co-authors have no conflict of interest.

SOURCE OF SUPPORT

A Research Grant for Longevity Sciences (14C-3) from the Ministry of Health, Labor and Welfare of Japan.

REFERENCES

1) Ministry of Health, Labor and Welfare of Japan. Abridged Life Table For Japan, 2010. (Accessed September 9, 2011, at http://www.mhlw.go.jp/english/database/db-hw/lifetb10/1.html.)
2) Ulander K, Jeppsson B, Grahn G. Quality of life and independence in activities of daily living preoperatively and at follow-up in patients with colorectal cancer. *Support Care Cancer*, 1997; 5:402–409.
3) Amemiya T, Oda K, Ando M, Kawamura T, Kitagawa Y, Okawa Y, Yasui A, Ike H, Shimada H, Kuroiwa K, Nimura Y, Fukata S. Activities of daily living and quality of life of elderly patients following elective surgery for gastric and colorectal cancers. *Ann Surg*, 2007; 246: 222–228.
4) Crosby D. Surgical care for the elderly in the United Kingdom. *In: Surgical care for the elderly*. 2nd edition, edited by Adkins RB Jr, Scott H Jr. pp. 503–511, 1998, Lippincott-Raven, Philadelphia.
5) Katlic M. Principles of geriatric surgery. *In: Principles and practice of geriatric surgery*, edited by Rosenthal RA, Zenilman ME. pp.92–104, 2001, Springer, New York.
6) Copeland GP, Jones D, Walters M. POSSUM: a scoring system for surgical audit. *Br J Surg*, 1991; 78:355–360.
7) Haga Y, Ikei S, Ogawa M. Estimation of Physiologic Ability and Surgical Stress (E-PASS) as a new prediction scoring system for postoperative morbidity and mortality following elective gastrointestinal surgery. *Surg Today*, 1999; 29: 219–225.
8) Common Toxicity Criteria v2.0 (CTC). Bethesda: National Cancer Institute, 1998. (Accessed November 25, 2006, at http://ctep.cancer.gov/reporting/ctc.html.)
9) Shelkey M, Wallace M. Katz index of independence in activity of daily living (ADL), 1998. (Accessed November 25, 2006, at:http://www.hartfordign.org/publications/trythis/issue02.pdfx.)
10) Katz S, Downs TD, Cash HR, Grotz RC. Progress in development of the index of ADL. *Gerontologist*, 1970; 10: 20–30.
11) Ware JE, Kosinski M, Turner-Bowker DM, Gandek B. How to score version 2 of the SF-12 health survey (with a supplement documenting version 1). Boston, MA: Health Assessment Lab, 2002.
12) Rosalind R, Franc C. EQ-5D: a measure of health status from the EuroQol Group. *Ann Med*, 2001; 33: 337–43.
13) Cockrell JR, Folstein MF. Mini-Mental State Examination (MMSE). *Psychopharmacol Bull*, 1988; 24: 689–692.
14) Anthony JC, LeResche L, Niaz U, von Korff MR, Folstein MF. Limits of the 'Mini-Mental State' as a screening test for dementia and delirium among hospital patients. *Psychol Med*, 1982; 12: 397–408.
15) Diggle PJ, Liang KY, Zeger SL. Analysis of longitudinal data. 1994, Oxford University Press, New York.
16) Pendergast DR, Fisher NM, Calkins E. Cardiovascular, neuromuscular, and metabolic alterations with age leading to frailty. *J Gerontol*, 1993; 48: 61–67.
17) Siebens H, Aronow H, Edwards D, Ghasemi Z. A randomized controlled trial of exercise to improve outcomes of acute hospitalization in older adults. *J Am Geriatr Soc*, 2000; 48: 1545–1552.
18) Stevanovic D, Radovanovic D, Pavlovic I, Kostic P. Effects of systematic lymphadenectomy on length of survival in patients with gastric carcinoma. *Med Pregl*, 2004; 57: 175–180.
19) Mukai M, Ito I, Mukoyama S, Tajima T, Saito Y, Nakasaki H, et al. Improvement of 10-year survival by Japanese radical lymph node dissection in patients with Dukes' B and C colorectal cancer: a 17-year retrospective study. *Oncol Rep*, 2003; 10: 927–934.
20) Kanemitsu Y, Hirai T, Komori K, Kato T. Survival benefit of high ligation of the inferior mesenteric artery in sigmoid colon or rectal cancer surgery. *Br J Surg*, 2006; 93: 609–615.
21) Sasako M. What is reasonable treatment for gastric adenocarcinoma? *J Gastroenterology*, 2000; 35 Suppl 12: 116–120.
22) National Health and Nutrition Examination Survey: Healthy weight, overweight, and obesity among US adults, 2003 (Accessed, October 28, 2009, at http://www.cdc.gov/nchs/data/nhanes/databriefs/adultweight.pdf)
23) Bamgbade OA, Rutter TW, Nafiu OO, Dorje P. Postoperative complications in obese and nonobese patients. *World J Surg*, 2007; 31: 556–560.

24) Furue H. Criteria for the direct effect of chemotherapy against solid cancer by Japanese Society for Cancer Therapy (in Japanese). *J Jpn Soc Cancer Ther*, 1986; 21: 931–942
25) Oken MM, Creech RH, Tormey DC, et al. Toxicity and response criteria of the Eastern Cooperative Oncology Group. *Am J Clin Oncol*, 1982, 5 (6): 649–655.
26) Japanese Research Society for Gastric Cancer: Japanese classification of gastric carcinoma. 1st English ed. 1999, Kanehara & Co., Ltd., Tokyo.
27) Japanese Society for Cancer of the Colon and Rectum: Japanese classification of colorectal carcinoma. 7th ed. 2006, Kanehara & Co., Ltd.,Tokyo.
28) AJCC Cancer Staging Manual. 6th ed. 2002, Springer, New York.