ORIGINAL

Validity of the Short Nutritional Assessment Questionnaire for Japanese Patients with Cancer Undergoing Outpatient Chemotherapy

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Abstract : Purpose : To investigate the utility of the Short Nutritional Assessment Questionnaire (SNAQ) in the nutritional evaluation of patients with cancer undergoing outpatient chemotherapy. Methods : We included 229 patients with cancer who were undergoing outpatient chemotherapy between October 2015 and April 2016. The SNAQ and the revised SNAQ (addition of age and body mass index) were implemented, and their relationships with Controlling Nutritional Status (CONUT), an indicator of bionutritional assessment, were examined. Results : The cutoff value of the SNAQ score corresponding to moderate-to-severe undernourishment in CONUT values was 0.5, with a sensitivity of 87.5% and a specificity of 65.9%, and the corresponding values for the revised SNAQ score were 2.5, 91.7%, and 62.9%, respectively. This cutoff value and the corresponding positive prediction value for the revised SNAQ were superior to those of SNAQ. Binary logistic regression analysis with the revised SNAQ and sex as independent variables and the CONUT value as the dependent variable revealed that the higher the SNAQ score, the more likely it was that CONUT moderate-to-severe undernourishment would be identified (odds ratio, 1.48 ; , 1.34-1.96) . Conclusion : Nutritional evaluation with the revised SNAQ can predict moderate-to-severe undernourishment according to CONUT in patients with cancer undergoing outpatient chemotherapy. J. Med. Invest. 64 : 117-121, February, 2017

INTRODUCTION

According to the 2014 patient survey by the Ministry of Health, Labour and Welfare, there were estimated 144,900 hospitalized patients with cancer and 231,600 cancer outpatients in Japan on the day of the survey, and these numbers are increasing each year (1). In recent years, outpatient cancer chemotherapy has been implemented not only for blood cancers, but also as adjuvant chemotherapy for advanced and recurrent cancer lesions, and surgery cases.

Patients with cancer who are undergoing chemotherapy are at risk for undernutrition associated with adverse events. However, nutritional management cannot be implemented as continuously for outpatients as it can be for hospitalized patients. According to a follow-up survey of 1,545 patients with cancer, risk factors for death within 2 months include metastasis, poor general health, advanced age, and severe undernutrition (2). It has also been reported that weight loss is associated with poor prognosis for patients with cancer who have undergone chemotherapy (3, 4).

In Japan, with the revision of medical fees in April 2016 (5), cancer was added to the target diseases for which nutritional dietary guidance is offered by national registered dietitians, and funds for outpatient nutritional dietary guidance were increased. Therefore, it is important to design nutritional management systems for outpatients with cancer.

If nutritional evaluation could be performed quickly for patients with cancer who are undergoing outpatient chemotherapy, undernutrition could be detected early and appropriate nutritional intervention could be performed on patients who required it. Simple nutritional evaluation tools include the Short Nutritional Assessment Questionnaire (SNAQ) developed in the Netherlands in 2005 and the Malnutrition Universal Screening Tool (MUST) proposed by the British Association for Parenteral and Enteral Nutrition (BAPEN). The validity of both the SNAQ (6) and the MUST (7) has been verified. The MUST has items that are evaluated by a health care provider, and the SNAQ is more suitable for evaluation by patients themselves.

The SNAQ is a simple nutritional evaluation method that, among 15 items for hospitalized patients, has some items that are most useful for outpatients' weight loss, loss of appetite, and use of nutritional supplements and/or tube feeding. We used the SNAQ to evaluate the nutritional status of Japanese patients with cancer who were undergoing outpatient chemotherapy. Miura *et al.* (8) reported that about 20% of these outpatients needed nutritional

intervention. However, it is unclear whether the SNAQ is useful for the nutritional evaluation of patients with cancer who are undergoing outpatient chemotherapy. Leistra *et al.* (9) reported validity of the revised SNAQ in which age and body mass index (BMI) were added to the traditional SNAQ. The result showed that the sensitivity of revised SNAQ was higher than the traditional SNAQ. Therefore, this study investigated the relationship between the SNAQ and Controlling Nutritional Status (CONUT) (10) as a bionutritional assessment or between the revised SNAQ and CONUT and examined the utility of the SNAQ and the revised SNAQ as the primary screening tool for patients receiving outpatient chemotherapy.

In this study, we used CONUT as an indicator of bionutritional assessment. CONUT is a scale for nutritional evaluation that scores serum albumin level (ALB), total cholesterol (T-cho), and total lymphocyte count (TLC). CONUT has been reported as a useful nutritional evaluation tool in a comparative examination with Subjective Global Assessment (SGA) (11), and there have been several reports of its clinical value (12-14).

If the relationship between CONUT values and SNAQ scores or between CONUT values and the revised SNAQ scores is clarified in various settings, simple nutritional evaluation using the SNAQ or the revised SNAQ will become possible. Therefore, we used the SNAQ and the revised SNAQ in which age and BMI were added to the evaluation criteria, for the nutritional evaluation of patients with cancer who were undergoing outpatient chemotherapy and examined their utility in determining the risks of moderate and severe undernutrition according to CONUT values.

MATERALS AND METHODS

The subjects of this study were patients with cancer who were undergoing outpatient chemotherapy. The percentage of Japanese patients with cancer suffering from undernutrition has been reported as 16.3% by Miura *et al.* (8). Thus, with an estimated 16.3% of patients with cancer suffering from undernutrition, and a 95% confidence level at ±5%, we calculated the sample size from the estimate equation of the ratio of the population to be 210. Considering the possibility of dropouts, we set the target sample size at 300. We requested cooperation from 300 patients who were undergoing outpatient chemotherapy between October 2015 and April 2016 in the Department of Chemotherapy, University Hospital, Kyoto Prefectural University of Medicine, and out of 290 who

agreed to cooperate, we selected 229 as subjects after excluding those with missing data.

The patients were administered the survey on SNAQ 4 items while they were receiving infusion chemotherapy. In addition, we obtained information on patient characteristics (sex, age, name of the disease, Performance Status Scale by the Eastern Cooperative Oncology Group [ECOG PS]), and body measurements [height and weight]) and calculated the BMI as the weight in kilograms divided by the square of the height in meters. We measured levels of serum albumin, total cholesterol, and TLC calculated CONUT values. For the evaluation of nutritional status, CONUT values of 0-1 were considered normal, values of 2-4 were considered to indicate mild undernutrition, values of 5-8 were considered to indicate moderate undernutrition, and values of 9-12 were considered to indicate severe undernutrition (Table 1).

In the SNAQ questions, patients were asked whether they had experienced any of the following : weight loss of 6 kg or more within the previous 6 months (3 points), weight loss of 3 kg or more within the previous 1 month (2 points), loss of appetite within the previous 1 month (1 point), and use of nutritional supplements or tube feeding within the previous 1 month (1 point). The maximum total score was 7 points.

In the revised SNAQ (9), age and BMI were added to the traditional SNAQ score. Patients under 65 years of age with BMI less than 18.5 and those aged 65 years or more with BMI less than 20 received an additional 3 points. Patients under 65 years of age with BMI less than 18.5-20 and those aged 65 years or more with BMI less than 20-22 received an additional 2 points. Thus, the maximum total score was 10 points.

Patients were classified according to their nutritional status as measured by the SNAQ and the revised SNAQ as follows : total score of 0-1 indicates undernourished, 2 indicate moderately undernourished, 3 or higher indicates severely undernourished.

Statistical analysis

We summarized patient characteristics.

We investigated the prediction ability and cutoff value utility of the SNAQ and revised SNAQ scores in relation to the determination of moderate and severe undernourishment by CONUT. To that end, we calculated the receiver operating characteristics (ROC) curve. For determination of CONUT (moderate and severe/normal and mild), to calculate the odds ratio for each 1 point of increase in the revised SNAQ score, we performed a logistic regression analysis with sex as the adjustment variable. For logistic

Table 1   Assessment of the screening tool for controlling nutritional status (CONUT)

Parameter	Normal	Mild	Moderate	Severe
Serum albumin (ALB) (g/dl)	≥ 3.50	3.49-3.00	2.99-2.50	< 2.5
①ALB score	0	2	4	6
Total lymphocyte count (TLC) (/μl)	≥ 1600	1599-1200	1199-800	< 800
②TLC score	0	1	2	3
Total cholesterol (T-cho) (mg/dl)	≥ 180	179-140	139-100	< 100
③T-cho score	0	1	2	3
*Total CONUT score	0-1	2-4	5-8	9-12
Dysnutritional states	Normal	Mild	Moderate	Severe

*CONUT score=①ALB score+②TLC score+③T-cho score

Table 1 shows CONUT values. The COUNT value is calculated using ALB, TLC, and T-cho

regression estimates, 95% confidence intervals were calculated. The analytical software IBM SPSS Statistics Version 23 (IBM Corp.) was used to for the analyses.

Ethical considerations

The patients were given an outline of the study and informed that necessary information, such as blood test results, would be collected from medical files and that personal information would be protected. Signed informed consent to participate in the study was then obtained. This study was approved by the medical ethics review committees of Kyoto Prefectural University of Medicine (approval number : ERB-E-292-2) and Kyoto Prefectural University (approval number : 117).

RESULTS

Patient characteristics

Patient characteristics are shown in Table 2. The mean age of the patients was 66.8 ± 10.2 years. Colorectal cancer was the most common type of cancer, followed by malignant lymphoma and breast cancer. Thirty-five of the 229 patients (15.3%) had a BMI less than 18.5. Forty patients (17.5%) had serum albumin levels less than 3.5 g/dL. On the basis of CONUT scores, 4 patients (1.7%) were determined to have severe undernutrition and 20 patients (8.7%) were determined to have moderate undernutrition.

Responses to SNAQ questions

Table 3 shows patients' responses to SNAQ questions. Gradual weight loss of 6 kg or more within the previous six months was reported by 36 patients (15.7%), and rapid weight loss of 3 kg or more within the previous 1 month was reported by 23 patients (10.0%). Sixty-four patients (27.9%) reported that they had experienced loss of appetite within the previous month.

Nutritional evaluation using the SNAQ and the revised SNAQ

Table 4 shows Assessment of nutritional status according to SNAQ and revised SNAQ. According to the SNAQ, 54 patients (23.6%) were classified as moderately or severely undernourished. According to the revised SNAQ, 121 patients (52.8%) were classified as moderately or severely undernourished.

ROC curves for SNAQ and revised SNAQ scores for CONUT values

Figure 1 shows the ROC curves of CONUT values, SNAQ scores, and revised SNAQ scores. The cutoff value for SNAQ scores corresponding to moderate or severe undernutrition in CONUT values was 0.5, with a sensitivity of 87.5%, a specificity of 65.9%, and an area under the ROC curve of 0.806. The cutoff value of the revised SNAQ score was 2.5, with a sensitivity of 91.7%, a specificity of 62.9%, and an area under the ROC curve of 0.815. With the SNAQ score, the boundary to identify moderately and severely undernourished with CONUT value was identified as not undernourished. In contrast, the revised SNAQ was able to identify the group that was severely undernourished, and the area under the ROC curve was large. Therefore, it can be concluded that the revised SNAQ can predict the CONUT value better than the original SNAQ.

Comparison of revised SNAQ scores and CONUT values by multiple logistic regression analysis

Table 5 shows multinomial logistic model describing the association between and SNAQ revised SNAQ. To investigate the relationship between the SNAQ, revised SNAQ scores and the CONUT values, we performed a binary logistic regression analysis using the SNAQ scores, revised SNAQ scores and two groups of CONUT values as dependent variables. The results showed that the higher

Table 2 Basic characteristics of the subjects	n = 229
Sex	
Male	110 (48.0)
Female	119 (52.0)
Age (years)	
Age< 65	76 (33.2)
Age≥ 65	153 (66.8)
Disease of the subjects	
Colorectal cancer	52 (22.7)
Malignant lymphoma	48 (21.0)
Breast cancer	45 (19.7)
Stomach cancer	21 (9.2)
Pancreas cancer	18 (7.9)
Rectal cancer	11 (4.8)
Cholangiocarcinoma	8 (3.5)
Multiple myeloma	7 (3.1)
Esophageal cancer	6 (2.6)
Gallbladder cancer	3 (1.3)
Small intestine cancer	2 (0.9)
Myelodysplastic syndrome	2 (0.9)
Primary macroglobulinemia	2 (0.9)
Liver cancer	1 (0.4)
Peritoneal pseudomyxoma	1 (0.4)
Gastrointestinal cancer of unknown primary	1 (0.4)
Castleman's disease	1 (0.4)
ECOG-PS*	
0	127 (55.5)
1	87 (38.0)
2	14 (6.1)
3	1 (0.4)
4	0 (0.0)
BMI categrory	
BMI< 18.5	35 (15.3)
BMI=18.5-25	156 (68.1)
BMI≥ 25.0	38 (16.6)
TLC< 900/µl	37 (16.2)
TP< 6.5 g/dL	113 (49.3)
ALB< 3.5 g/dL	40 (17.5)
T-cho< 140 mg/dL	30 (13.1)
CONUT score categrory	
Severe (9≤)	4 (1.7)
Moderate (5-8)	20 (8.7)
Mild (2-4)	110 (48.0)
Normal (0-1)	95 (41.5)

Data are presented as n (%)
*ECOG-PS : Performance Status Scale of Eastern Cooperative Oncology Group

The percentage shows the number of patient characteristics.

Table 3   Assessment of nutritional status according to SNAQ item
n = 229

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Weight loss > 6 kg in the last months	36 (15.7)
Weight loss > 3 kg in the last month	23 (10.0)
Decreased appetite last month	64 (27.9)
Use of sip/tube feed last month	13 (5.7)

n (%)

The percentage shows the number of each item of SNAQ.

Table 4   Assessment of nutritional status according to SNAQ and revised SNAQ
n = 229

SNAQ score	
No undernourished (0-1)	175 (76.4)
Moderate undernourished (2)	8 (3.5)
Severe undernourished (3≤)	46 (20.1)
Reviesd SNAQ score	
No undernourished (0-1)	108 (47.2)
Moderate undernourished (2)	23 (10.0)
Severe undernourished (3≤)	98 (42.8)

n (%)

The percentage shows the number of nutritional evaluation using the SNAQ and the revised SNAQ.
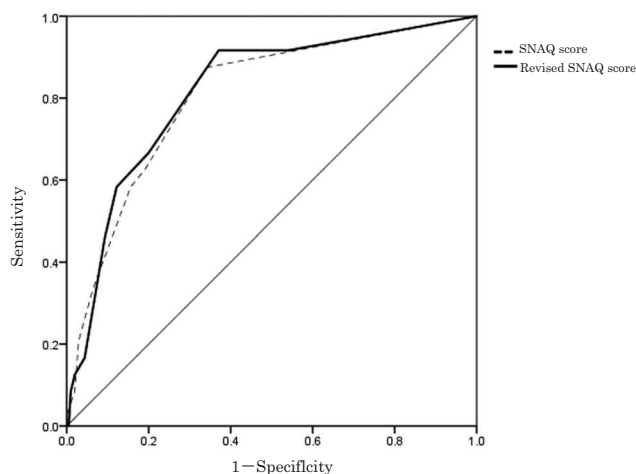
Figure 1   ROC curve of the SNAQ and revised SNAQ in the severely malnourished patients against the objective standard of malnutrition
Area under the curve (AUC) of the SNAQ score (95%CI) : AUC = 0.806, CI = 0.714-0.897
Area under the curve (AUC) of the revised SNAQ (95%CI) : AUC = 0.815, CI = 0.726-0.904

Table 5   Multinomial logistic model describing the association between SNAQ and revised SNAQ
n = 229

	Odds ratio	(95%CI)
SNAQ (by 1 point)	1.09	(0.67-1.77)
Revised SNAQ (by 1 point)	1.48	(1.34-1.96)

Logistic regression analysis using the SNAQ scores and the revised SNAQ score and two groups of CONUT values as dependent variables.

the SNAQ value, the more patients were identified as moderately and severely undernourished according to CONUT scores (odds ratio, 1.48 ; 95% confidence interval, 1.34-1.96).

DISCUSSION

We examined the validity of the SNAQ and the revised SNAQ for patients with cancer who were undergoing outpatient chemotherapy. In compared with the SNAQ, the results of the revised SNAQ showed that the sensitivity, specificity, and area under the ROC curve of the revised SNAQ scores to CONUT values were 91.7%, 62.9%, and 0.815, respectively. The group that was identified as moderately or severely undernourished by CONUT values was identified as severely undernourished by the revised SNAQ score, thus demonstrating that this score could be useful for primary nutritional screening.

In this study, although the sensitivity and specificity of the SNAQ score for the group identified as moderately or severely undernourished by CONUT values were 87.5% and 65.9%, respectively, the sensitivity and specificity of the revised SNAQ score were 91.7% and 62.9%, respectively. Therefore, the revised SNAQ, with age and BMI added as items, provided higher sensitivity than the original SNAQ. These results were consistent with a previous study by Leistra *et al.* (9) that examined the validity of the SNAQ in outpatients. The study showed that the sensitivity and specificity of the SNAQ (43% and 99%, respectively) increased to 95% and 99% with the use of the revised SNAQ. BMI, which was added to the revised SNAQ, is an easy and useful indicator to evaluate nutritional status. Age is said to impact nutritional status, and with aging, changes in digestion, absorption, and energy metabolism are said to lead to undernutrition (15). Therefore, it appears that the addition of age and BMI to the evaluation criteria increased the sensitivity of the evaluation.

Kruizenga *et al.* (16) reported that patients identified as suffering from undernutrition (with a SNAQ score of 3 points or higher) had low serum albumin, BMI, grip strength, and quality of life (QOL). Identification of undernutrition with the SNAQ can be an indicator of the patient's general condition and QOL.

To perform nutritional screening of all patients with cancer who are undergoing outpatient chemotherapy, the evaluation must be easily implemented and accurate. The SNAQ could be a practical nutritional evaluation tool. In a large-scale survey, Kruizenga *et al.* (17) reported that the departments with a high proportion of undernourished patients were geriatrics, oncology, gastroenterology, and internal medicine. Rojer *et al.* (18) evaluated the nutritional status of four groups of subjects hospitalized middle-aged patients, elderly outpatients, healthy elderly people, and healthy young people based on a BMI of 18.5 or less, rate of weight loss, age-corrected BMI, and lean body mass and showed that the results were different for each group. We hope to develop a nutritional risk score that is specialized for patients with cancer who are undergoing outpatient chemotherapy by adding items such as type of cancer, department where the patient is treated, and symptoms, with the aim of providing continuous nutritional evaluation and management.

A limitation of the present study was that the specificity of the revised SNAQ was 62.9%. This may have been because nutritional evaluation with the SNAQ for the chief complaint is not reflected in CONUT values. However, this low specificity is unlikely to place a burden on patients or affect costs.

Another limitation is that in the revised SNAQ, the proportion of patients identified as severely undernourished was high, at 42.8%. In the revised SNAQ, those who are under 65 years of age with BMI less than 20 and those who are 65 years of age or older with BMI of less than 22 are given an additional 3 points, which increases

the proportion of severely undernourished patients. Thus, the validity of the additional points must be examined.

And another limitation is that it is not considered the effects of clinical department cancer type, severity of cancer or chemotherapy regimen. Therefore, we need to improve accuracy as screening by adding items such as clinical department, cancer type and chemotherapy regimen to the score.

Finally, although the CONUT bionutritional indicator was useful in identifying patients who were moderately or severely undernourished, it cannot identify mild undernutrition. If continuing to undergo chemotherapy causes patients who have been identified as being mildly undernourished to become moderately or severely undernourished, early-stage nutritional intervention will be necessary.

In conclusion, the results suggest that the revised SNAQ, which can identify the risk of moderate and severe undernourishment in patients with cancer who are undergoing outpatient chemotherapy in Japan, could be a useful primary screening tool.

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest.

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