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Original Article

Factors affecting the performance of activities of daily living in patients with advanced cancer undergoing inpatient rehabilitation: results from a retrospective observational study

Kaori Shimoda, OTR, PhD[1)*], Hisao Imai, MD, PhD[2)], Tetsuya Tsuji, MD, PhD[3)], Kenji Tsuchiya, OTR, PhD[1)], Hiroshi Tajima, RPT[4)], Hatsumi Kanemaki, RPT[4)], Fusae Tozato, OTR, PhD[5)]

[1)] *Department of Rehabilitation Sciences, Gunma University Graduate School of Health Sciences: 3-39-22 Showa-machi, Maebashi-shi, Gunma 371-8514, Japan*
[2)] *Division of Respiratory Medicine, Gunma Prefectural Cancer Center, Japan*
[3)] *Department of Rehabilitation Medicine, Keio University School of Medicine, Japan*
[4)] *Division of Rehabilitation, Gunma Prefectural Cancer Center, Japan*
[5)] *Nagano University of Health and Medicine, Japan*

Abstract. [Purpose] Many clinicians believe that rehabilitation for patients with advanced cancer is futile. We determined factors affecting the performance of activities of daily living in patients with advanced cancer based on age, gender, marital status, living arrangement, rehabilitation intensity, type of cancer, impairment, metastasis, and active cancer treatment. [Participants and Methods] We assessed the Barthel Index to evaluate the performance of activities of daily living. Of the 120 adult patients with cancer who underwent inpatient rehabilitation, we analyzed the Barthel Index scores, consisting of 10 items, and reviewed the clinical characteristics from the medical records of 48 patients who completed supportive or palliative rehabilitation according to Dietz and showed an increased or maintained total Barthel Index score at final evaluation. [Results] The median total Barthel Index score increased from 45 (5–95) to 72.5 (5–100); the rehabilitation intensity was 320 (40–1,240) minutes. The analytical results showed that the increase of total Barthel Index score was positively associated with rehabilitation intensity (β=0.350) and negatively associated with the initial grooming score (β=−0.277). [Conclusion] Adequate rehabilitation positively affects performance of activities of daily living, especially in patients with advanced cancer who lost their grooming ability at the onset of rehabilitation. Importantly, rehabilitation may be beneficial for patients with advanced cancer.

Key words: Activities of daily living, Cancer inpatients, Palliative care

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INTRODUCTION

Cancer is one of the most prevalent, disabling, and costly medical conditions[1)]. The number of people living with cancer has been increasing because of advances in the early detection and treatment of cancer, as well as aging and growth of the population[2)]. For most patients with advanced cancer, both the physiological effects of the cancer itself and cancer treatment can result in physical impairment[3)]. Such impairment, including dysfunction of the nervous, muscular, skeletal, and internal organ systems, is a factor that contributes to disabilities[4)].

*Corresponding author. Kaori Shimoda (E-mail: kaoris@gunma-u.ac.jp)

Occupational and physical therapists work with critically ill patients to create realistic and meaningful goals for improving comfort, mobility, socialization, and performance of activities of daily living (ADL), regardless of disease state and medical status[5]. Dietz[6] has classified cancer rehabilitation into four categories according to cancer patients' physical and demonstrated needs: preventive, restorative, supportive, and palliative. The Dietz classification, as summarized by Silver et al.[7], is as follows: 1) Preventive includes interventions that will lessen the effect of expected disabilities; 2) Restorative includes interventions that attempt to return patients to previous levels of physical, psychological, social, and vocational functioning; 3) Supportive includes interventions designed to teach patients to adapt to their disabilities and minimize debilitating changes from ongoing disease; and 4) Palliative includes interventions focused on minimizing or eliminating complications and providing comfort and support. Dietz insisted that the treatment goal of rehabilitation should be selected for each patient after initial evaluation at the onset of care[6].

Rehabilitation, even in the advanced phases of illness, can help to restore or maintain function or ameliorate the functional decline through exercises for range of motion, pain relief, and improving performance of ADL[8]. It is reasonable to assume that patients with advanced cancer may recover autonomy for performance of ADL, as do patients with other advanced and end-stage diseases[9]. However, many clinicians and researchers have held the view that for patients with advanced cancer, rehabilitation is futile, trivial, or even inappropriate[10]. By undergoing adequate rehabilitation, cancer patients in the restorative phase can increase the performance of ADL compared to patients in the supportive or palliative phase[4]. However, 73% of patients in the supportive phase who completed 90-day rehabilitation improved or maintained their performance of ADL[11]. In addition, 239 of 301 patients with cancer undergoing rehabilitation in the palliative (defined as "terminal") phase increased the score of several items on the Barthel Index (BI) when they reached the maximum level of the performance of ADL[12]. The BI is widely used to assess functional performance of ADL[13]. Notwithstanding, there are no reports showing factors affecting the increase of total BI score of patients with advanced cancer undergoing rehabilitation in the supportive and palliative phases. We believe that finding the factors affecting the increase of total BI score of these patients may break through primary barriers to optimal delivery of rehabilitation in the supportive and palliative phases.

This study aimed to determine factors affecting the performance of ADL of patients with advanced cancer undergoing inpatient rehabilitation. We defined the patients with advanced cancer as patients who needed supportive or palliative rehabilitation under the Dietz classification[6], and we analyzed only patients who increased or maintained their total BI score during rehabilitation.

PARTICIPANTS AND METHODS

This study was a retrospective observational study. All patients provided written informed consent. The study protocol was approved by the Institutional Review Board of our cancer center (Approval No. 405-27030) and was conducted as per the Helsinki Declaration[14].

This study recruited all patients with cancer who were enrolled in our cancer center in Japan between July 8 and December 11, 2015 and who underwent inpatient rehabilitation conducted by occupational or physical therapists. The exclusion criteria were as follows: (1) death or inability to complete the rehabilitation because of worsening physical condition; and (2) being classified as having preventive or restorative needs under the Dietz classification[6]. Conversely, we included all patients with hematological malignancy because it was difficult to categorize them using the Dietz classification[6]. Moreover, we excluded 2 patients who obtained a full total BI score at the beginning of rehabilitation (the 'initial total BI score' in this study) and 4 patients who had an initial total BI score higher than the score at the end of rehabilitation (the 'final total BI score' in this study). We set these exclusion criteria because our purpose was to determine the factors affecting the increase of total BI score of patients with advanced cancer undergoing rehabilitation in the supportive and palliative phases.

We considered that the following demographic variables might be associated with performance of ADL in our patients: age, gender, marital status, living arrangement, rehabilitation intensity, type of cancer, impairment, metastasis, and active cancer treatment during rehabilitation. In this study, we defined rehabilitation intensity as the sum of rehabilitation units (one unit=20 minutes) throughout the rehabilitation intervention. In Japan, the universal healthcare insurance system allows patients with cancer to receive ≤6 units (120 minutes) of rehabilitation per day. Impairment was classified according to the International Classification of Functioning, Disability and Health[15]. Duplication in the type of cancer and impairment was permitted in this study. These patient demographics were extracted from the medical records of each patient by the authors who were occupational or physical therapists.

Generically, disability, age, gender[16], marital status, and living arrangement[17] affect performance of ADL. In patients with stroke, rehabilitation intensity has a good effect on increasing total BI score[18]. In previous studies of patients with cancer, the type of cancer, impairment, metastasis, and active cancer treatment during rehabilitation influenced the change in performance of ADL, although the conclusions differed[4, 19, 20].

We evaluated total BI score to assess performance of ADL. The BI consisted of 10 items: feeding, transfer, grooming, toileting, bathing, ambulation, stairs, dressing, bowels, and bladder[21]. The total BI score was calculated by summing the scores of all items[21]. The BI has been shown to be a reliable, valid, and responsive assessment of performance of ADL in patients with stroke[22]. A score of 0 is given for each item when the patient cannot meet the criteria[21]. If the patient achieves a full total BI score of 100, she or he is able to live without attendant care[21]. We considered that the initial total and each

item of BI scores would be associated with an increase of total BI score and each item of BI score of patients in this study. A patients' initial total BI score is used to predict the final total BI in stroke patients[23, 24]. In addition, there is a clear difference in the performance of each item of BI[25].

We also evaluated the patients' Eastern Cooperative Oncology Group Performance Status scale (PS)[26]. The validity and reliability of PS have been shown to exhibit good results[27, 28]. PS is ordinarily used to evaluate the severity of toxicity experienced by patients in cancer treatment trials[27, 29], but can also evaluate the performance of ADL[30], quality of life[31], and psychological distress[32] in these patients. The measurement uses a scale of 0 through 4, with 0 to 1 indicating good PS and 2 to 4 indicating poor PS[29, 33].

These evaluations were scored and collected at the beginning and end of a patient's rehabilitation by authors who were occupational or physical therapists who also provided rehabilitation.

The comprehensive rehabilitation procedures are listed here, based on a report by Yoshioka[12]: performance of ADL exercise, balance exercise, cognitive functioning exercise, comfortable or relaxed positioning with pillows for the relief of pain or prevention of joint contracture, discharge support, endurance training, introduction of self-help device, massage therapy, muscle strength exercise, prevention of lymphedema, psychological support, pulmonary rehabilitation, range of motion exercise, speech rehabilitation, swallowing exercise, use of brace, and others. Patients with advanced cancer have various symptoms such as fatigue, pain, lack of energy, weakness, and loss of appetite[34]. Therefore, these procedures were used alone or in combination with some modifications, according to each patient's condition and complaints. In addition, rehabilitation intensity varied from 0 to 6 units (from 0 to 120 minutes) each day, based on the judgment of the occupational or physical therapist according to the patient's overall status. Rehabilitation was conducted either in the rehabilitation room or at the patient's residence. If their condition was well enough to continue the rehabilitation, it was continued until their hospital discharge or until their rehabilitation goal was achieved.

The increase of BI score was calculated as the final score minus the initial score. As dependent variables, we selected the increase of total BI score as well as the increase of each item of BI score. We used Spearman's rank correlation coefficient to explore correlations between an increase of total BI score and each item of BI score, as BI scores were not normally distributed. The obtained coefficient of correlation values was used to select the dependent variables from 10-increase of each item of BI. Although BI score was not normally distributed, to determine which variables were independently associated with the increase of total BI score and each item of BI score, a stepwise multiple regression analysis was performed. This was based on previous studies using multiple regression analysis to investigate predictive factors that were significantly associated with the change of total BI score, while noting that the BI score was not normally distributed[35–37].

We used the following items as independent variables: patient age, gender (1=male, 0=female), marital status (married, widowed, divorced, single, and unknown; 1=presence of each category, 0=absence of each category), living arrangements (living with family, living alone, and others; 1=presence of each category, 0=absence of each category), rehabilitation intensity, types of cancer (hematological malignancy, gastrointestinal, lung, genitourinary, breast, head and neck, and others; 1=presence of each category, 0=absence of each category), impairments (neuromusculoskeletal and movement-related functions; sensory functions and pain; functions of the cardiovascular, hematological, immunological and respiratory systems; mental functions; functions of the digestive, metabolic and endocrine systems; and structures of the nervous system; 1=presence of each category, 0=absence of each category), metastasis (1=yes, 0=no), active cancer treatments during rehabilitation (supportive care, chemotherapy, radiation therapy, and combination of chemotherapy and radiation therapy; 1=presence of each category, 0=absence of each category), and initial total BI score and each item of BI score. The reason we selected initial total BI score and each item of BI score as the independent variables was to evaluate the increase from baseline for total BI score and each item of BI score. Multicollinearity diagnostic testing was performed, and residual distribution was checked.

Statistical significance was set at a p-value of less than 0.05. All statistical analyses were performed using IBM SPSS Statistics version 25.

RESULTS

Initially, 120 Japanese patients who underwent inpatient rehabilitation were included in this study. The authors were able to obtain complete data for 119 of the patients. Rehabilitation was discontinued in 21 patients who died during hospitalization, and in 22 patients because of worsening condition. Eleven patients were identified as being in the prevention phase and another 11 as in the restorative phase. Two patients received a full initial total BI score, and 4 patients had lower final scores than the initial scores because of their worsening condition. Finally, 48 patients (21 males [44%]) with an average age of 69.0 years (SD=12.2, range 31–91 years) were included in this study (Fig. 1).

The basic demographic characteristics at baseline are shown in Table 1. Thirty-eight patients (79%) had metastasis. Active cancer treatment during rehabilitation was as follows: supportive care (n=23, 48%), chemotherapy (n=18, 38%), radiation therapy (n=4, 8%), and a combination of chemotherapy and radiation therapy (n=3, 6%).

The median rehabilitation intensity was 320 (40–1,240) minutes. The PS at final evaluation was as follows: 0 (n=0, 0%), 1 (n=1, 2%), 2 (n=17, 35%), 3 (n=24, 50%), and 4 (n=6, 13%). The total BI score increased in 37 patients, while the initial BI scores were maintained in 11 patients. The initial and final BI scores are shown in Table 2.

The correlation coefficient between the increase of total BI score and increase of transfer score (r=0.736), ambulation

Table 1. Patient demographics at baseline (n=48)

Age in years, mean ± SD (range)	69.0 ± 12.2 (31–91)
Gender, n (%)	
Male	21 (44%)
Female	27 (56%)
PS, n (%)	
0	0 (0%)
1	1 (2%)
2	5 (10%)
3	34 (71%)
4	8 (17%)
Type of cancer, n (%)	
Hematological malignancy	19 (35%)
Gastrointestinal	11 (20%)
Lung	10 (18%)
Genitourinary	6 (11%)
Breast	3 (5%)
Head and neck	2 (4%)
Others	4 (7%)
Impairments classified according to ICF, n (%)	
Neuromusculoskeletal and movement-related functions	18 (32%)
Sensory function and pain	16 (29%)
Functions of the cardiovascular, hematological, immunological, and respiratory systems	10 (18%)
Mental functions	10 (18%)
Functions of the digestive, metabolic and endocrine systems	1 (2%)
Structures of the nervous system	1 (2%)
Marital status, n (%)	
Married	31 (65%)
Widowed	6 (13%)
Divorced	2 (4%)
Single	3 (6%)
Unknown	6 (13%)
Living arrangement, n (%)	
Living with family	40 (83%)
Living alone	6 (13%)
Others	2 (4%)

PS: Eastern Cooperative Oncology Group Performance Status scale; ICF: the International Classification of Functioning, Disability and Health.

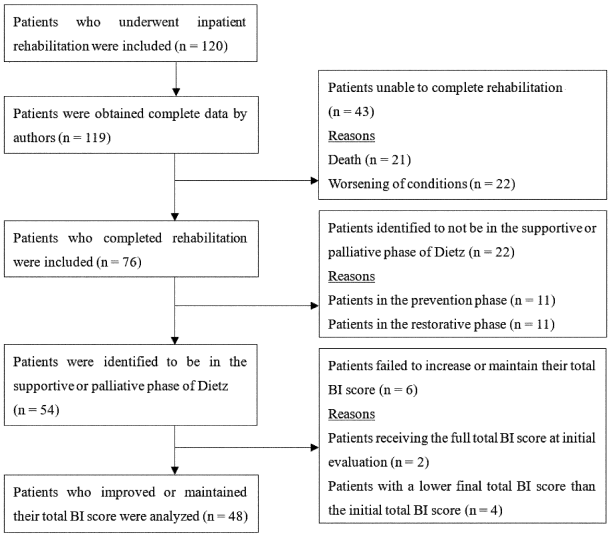

Fig. 1. Study flow chart.
BI: Barthel Index.

Table 2. Median Barthel Index score of patients (n=48)

	Initial		Final	
Each item (score range)	Median	Range	Median	Range
Total (0–100)	45	5–95	72.5	5–100
Feeding (0–10)	10	0–10	10	0–10
Transfer (0–15)	10	0–15	12.5	0–15
Grooming (0–5)	0	0–5	5	0–5
Toileting (0–10)	5	0–10	10	0–10
Bathing (0–5)	0	0–5	0	0–5
Ambulation (0–15)	0	0–15	10	0–15
Stairs (0–10)	0	0–5	0	0–10
Dressing (0–10)	5	0–10	5	0–10
Bowels (0–10)	10	0–10	10	0–10
Bladder (0–10)	10	0–10	10	0–10

score (r=0.706), and toileting score (r=0.614) were particularly high (p<0.001).

The increase of total BI score was positively associated with rehabilitation intensity (β=0.350, p=0.012) and negatively associated with initial grooming score (β=−0.277, p=0.042) (Table 3).

The increase of ambulation score was positively associated with the initial total BI score (β=0.452, p=0.041) and negatively associated with initial ambulation score (β=−0.728, p=0.001) (Table 3). The increase of toileting score was negatively associated with being male (β=−0.294, p=0.021) and the initial toileting score (β=−0.480, p<0.001) (Table 3).

DISCUSSION

The increase of total BI score was positively associated with rehabilitation intensity and negatively associated with initial grooming score. Several studies have reported that intensive inpatient rehabilitation increases total BI score of patients with

Table 3. Result of stepwise multiple regression analysis of increase of total and each item of Barthel Index score (n=48)

Dependent variables	Independent variables	B	95% CI for β		Standardised β	p value	Adjusted R^2
			Lower limit	Upper limit			
Increase of total BI score	Rehabilitation intensity	0.525	0.123	0.926	0.350	0.012	0.202
	Initial grooming score	−2.265	−4.450	−0.080	−0.277	0.042	
Increase of transfer score	None						
Increase of ambulation score	Initial total BI score	0.090	0.004	0.175	0.452	0.041	0.180
	Initial ambulation score	−0.630	−1.005	−0.256	−0.728	0.001	
Increase of toileting score	Male	−1.499	−2.766	−0.233	−0.294	0.021	0.287
	Initial toileting score	−0.322	−0.489	−0.155	−0.480	<0.001	

CI: confidence interval.

stroke[18, 38]. Similar results have been reported in stroke patients who had undergone post-discharge rehabilitation[39]. Higher intensity rehabilitation increases total BI score of patients in post-acute care facilities[40–43]. The effects of early rehabilitation intervention in an intensive care unit are still obscure[44]. Our results suggest that even patients with advanced cancer enjoy benefits from adequate rehabilitation, as is the case with patients with other diseases. Cheville et al.[9] suggest that rehabilitation should be considered for all patients with advanced cancer who are experiencing functional decline. We believe this novel finding will promote the utilization of cancer rehabilitation, regardless of the phase of patients. In this study we noticed an improvement of PS score, which includes the assessment of psychological aspects[32, 45]. Psychological effects may partly contribute to the beneficial effects of rehabilitation for patients with advanced cancer. Therefore, rehabilitation may be beneficial for patients with advanced cancer.

We also found that increase of total BI score was influenced by grooming ability as assessed at the onset of rehabilitation. Grooming requires patients to use devices or instruments, such as razors for shaving[46]. In addition, grooming is the ADL which is most affected in patients with cancer, along with walking and transfer[47]. This result shows that the initial grooming score may be a predictor of increase of total BI score in patients with advanced cancer.

Being male negatively affected increase of toileting score. Despite increased attention on gender, obstacles remain to measuring the influence of gender differences in health research[48]. In patients with stroke, multivariate analyses found that male patients had a three times higher probability than female patients of reaching a final high total BI score[49]. Male as well as increased comorbidity and greater age are considered to indicate a lower capacity for functional recovery in patients with hip fracture[50]. In recovery following mild traumatic brain injury, gender is not a strong prognostic indicator for recovery[51]. Adequate rehabilitation may improve the toileting ability of male cancer patients, although these reports suggest that there is insufficient evidence for a gender-specific effect, particularly because the correlation coefficient between the increase of total BI score and toileting score was high.

Our retrospective observational study with no control group has several limitations. First, we were unable to control for the following items. Our study population was heterogeneous in terms of cancer type, so that the cancers were of different severity and had varying speeds of progression. Our rehabilitation procedure was adjusted to individual needs. We did not evaluate physiological function such as handgrip strength and submaximal exercise capacity, but these factors may affect the increase of BI score. Accordingly, we were unable to rule out which factor is the most effective for determining the performance of ADL in our patients. Second, there was a selection bias. We included a small number of patients who underwent rehabilitation at a single institution in Japan. From this, the statistical power of the results was limited, and a type II error might have occurred. We analyzed only patients who increased or maintained their total BI score during rehabilitation. Therefore, we cannot generalize the present results for all patients with advanced cancer. Third, there is an information bias. The assessment, rehabilitation procedures, and data collection were conducted by authors who were occupational or physical therapists because of rehabilitation staff shortages. Finally, rehabilitation intensity may be affected by the duration of hospitalization and rehabilitation intervention, as well as rehabilitation frequency. We have to illuminate the relation between these items and increase of total BI score in further studies.

In conclusion, rehabilitation intensity had a positive effect regarding the increase of total BI score in this retrospective, observational study of patients with advanced cancer undergoing inpatient rehabilitation. Our results suggest that adequate rehabilitation has a positive effect on performance of ADL, especially when grooming ability is lost at the onset of rehabilitation. We believe that the current study supports rehabilitation for patients with advanced cancer. Nevertheless, further randomized control studies are needed to determine factors affecting the performance of ADL of patients with advanced cancer.

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Conflict of interest

None.

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