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Prognostic factors in mobility disability among elderly patients in the emergency department: A single-center retrospective study

Akiyoshi Nagatomi[1,2] | **Haruaki Wakatake**[1] | **Yoshihiro Masui**[1] | **Shigeki Fujitani**[2]

[1]Department of Emergency and Critical Care Medicine, St. Marianna University Yokohama City Seibu Hospital, Yokohama, Japan

[2]Department of Emergency and Critical Care Medicine, St. Marianna University, School of Medicine, Kawasaki, Japan

Correspondence
Akiyoshi Nagatomi, Department of Emergency and Critical Care Medicine, St. Marianna University, School of Medicine, 2-16-1 Sugao, Miyamae-ku, Kawasaki, Kanagawa 216-8511, Japan.
Email: akiyoshi.nagatomi@marianna-u.ac.jp

Abstract

Aim: We aimed to evaluate the clinical characteristics and outcomes of elderly critically ill patients and identify prognostic factors for mobility disability at discharge.

Methods: This single-center, retrospective cohort study investigated the period from April 2020 to January 2021. Patients ≥75 years old transferred to our emergency department and admitted to the intensive care unit (ICU) or intermediate unit in our hospital were eligible. Demographics, clinical characteristics, nutritional indicators, and nutritional screening scores were collected from chart reviews and analyzed. The primary outcome was the prevalence of mobility disability, compared to that of no mobility disability.

Results: A total of 124 patients were included in this present study. Median age was 83.0 years (interquartile range [IQR], 79.8–87.0 years) and 48 patients (38.7%) were female. Fifty-two patients (41.9%) could not walk independently at discharge (mobility disability group). The remaining 72 patients were in the no mobility disability group. Multiple logistic regression analyses revealed clinical frailty scale (CFS) score ≥5 (odds ratio [OR] = 6.63, 95% confidence interval [CI] = 2.51–17.52, $p < 0.001$), SOFA score ≥6 (OR = 6.11, 95% CI = 1.57–23.77, $p = 0.009$), and neurological disorder as the main cause on admission (OR = 4.48, 95% CI = 1.52–13.20, $p = 0.006$) were independent and significant prognostic factors for mobility disability at discharge.

Conclusion: Among elderly patients admitted to the emergency department, CFS ≥5, SOFA ≥6, and neurological disorders were associated with mobility disability at hospital discharge.

KEYWORDS
clinical frailty scale, frailty, elderly, mobility disability

INTRODUCTION

The elderly population has been increasing in Japan over the past few decades, and the number of older patients admitted to medical services has been increasing, particularly as transfers to the emergency department.[1] The number of Japanese people ≥75 years old who were transferred to the emergency department exceeded 2,540,000 in 2021.[2] Some elderly individuals are admitted to general wards, while others are admitted to an intensive care unit (ICU) or high-care unit (HCU), which represents an intermediate unit between an ICU and general ward.

Due to gradual improvements in mortality rates over a period of decades, even with admission to the ICU or HCU, long-term prognosis has been receiving increased attention recently.[3] However, physical and mental functions are deteriorated among many of these patients, and these symptoms are recognized as ICU-acquired weakness (ICU-AW) or post-intensive care syndrome (PICS).[4] These symptoms can affect activities of daily living (ADL) and finally increase the

burden of nursing care on the family. To prevent ICU-AW and PICS, early rehabilitation and nutritional management have been suggested as essential methods for obtaining good functional prognosis, and the ABCDEFGH bundle, which includes early rehabilitation, has also been advocated to prevent functional deterioration.[5–7]

Several predictors of functional outcomes for ICU patients have been reported in previous studies.[8–10] However, it is not yet apparent whether those scales are useful to predict mobility disability among elderly individuals transferred to the emergency department and admitted to an ICU or HCU.

In this report, we aimed to investigate the prevalence of mobility disability among elderly critically ill patients at hospital discharge, and to detect factors that can be used to predict the development of mobility disability.

METHODS

Subjects

We conducted this single-center, retrospective study at St. Marianna University, School of Medicine, Yokohama-city Seibu Hospital, Yokohama, Japan, between April 2020 and January 2021. Patients were transferred to the emergency department and admitted to the ICU or HCU. Elderly people were defined as those ≥75 years old, so individuals <75 years old were excluded from this study.[11] Patients who were unable to walk without assistance before ICU or HCU admission were also excluded.

Data collection

Patient information included demographic characteristics such as age, sex, body mass index (BMI), admission diagnosis, and treatment during hospitalization. The Charlson Comorbidity Index (CCI) was calculated for each patient. Severity was evaluated based on scores for the Acute Physiology and Chronic Health Evaluation (APACHE)-II and Sequential Organ Failure Assessment (SOFA). Frailty level before hospital admission was obtained from patients or proxies, with frailty defined according to the Clinical Frailty Scale (CFS). The CFS is an easy and intuitive determinable categorization tool based on simple visual descriptions. Patients with CFS ≥5 were defined as frail.[12]

Nutritional status of the patient was assessed according to the Nutritional Risk Screening-2002 (NRS2002) on admission.[13] This assessment tool was recommended to determine the nutritional risk status of all critically ill patients admitted to the ICU and to determine which patients were likely to benefit from early enteral nutrition.[14]

The ICU Mobility Scale (IMS) is an 11-item categorical scale, with scores ranging from 0 (lying/passive exercises in bed) to 10 (independent ambulation).[15] Patients with IMS score <9 were classified into a mobility disability group, while those with IMS score ≥9 were classified into a no mobility disability group. ADL was measured using the Barthel Index, as a scale from 0 (fully assisted) to 100 (independent). Length of stay (LOS) in the ICU or HCU and hospital LOS were also obtained.

All patients were followed during the hospital stay. The primary outcome was the prevalence of mobility disability (IMS score <9) on the day of hospital discharge.

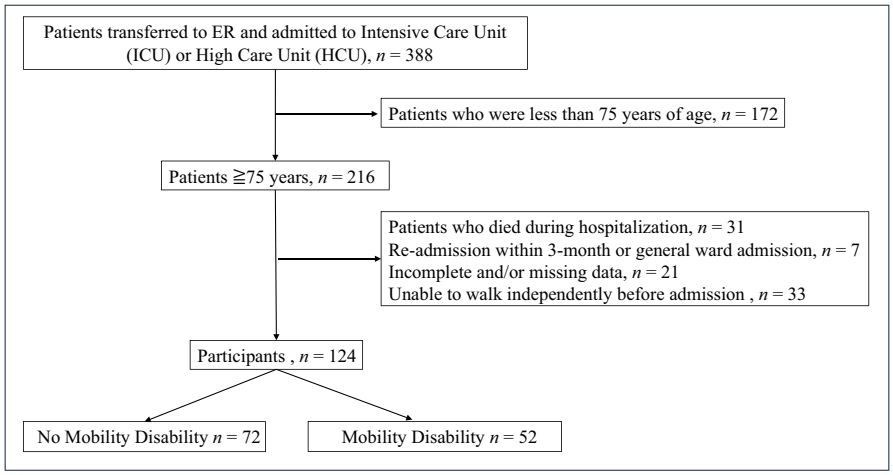
Statistical analysis

We compared variables between mobility disability and no mobility disability groups at hospital discharge. The homogeneity and distribution of variables were assessed using the Shapiro–Wilk test. Frequencies and percentages are presented as median (interquartile range [IQR]) according to the normality of data distributions. The Mann–Whitney *U* test was used for analyzing nonparametric data. Categorical variables were compared using the chi-squared test with Yates' continuity correction or Fisher's exact test. To build the model for multivariate analysis, we selected all candidate variables from univariate analyses with *p*-values below 0.05. The discriminatory ability of those variables for mobility disability was evaluated using receiver operating characteristic (ROC) curves, and areas under the curve (AUC) were calculated. The Youden index was used to establish the optimal cut-off value, and sensitivity and specificity were also calculated. We performed multivariate logistic regression analysis using all candidate variables. Two-sided alpha values <0.05 were considered statistically significant. Statistical analyses were completed using R statistical software, version 4.0.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

A total of 388 patients were admitted to the ICU or HCU during the study period. A total of 216 patients ≥75 years old in the ICU or HCU were assessed for eligibility. The prevalence of frailty (CFS ≥5) was 46.8% (101 patients) among these patients. Ninety-two elderly patients were excluded from the study for various reasons and 124 patients were enrolled in the study (Figure 1). Fifty-two (41.9%) of the 124 patients could not walk independently at discharge. Regarding COVID19, two of the 216 patients >75 years old were diagnosed with COVID-19. One died during hospitalization and the other was excluded because of immobility before admission.

The demographic characteristics and clinical findings are shown in Table 1. Median age of these patients was 83.0 years (IQR, 79.8–87.0 years) and 48 patients (38.7%) were female. Median BMI on admission was 21.1 kg/m^2 (IQR, 18.9–23.4 kg/m^2). Forty-two patients (33.9%) had a BMI <20.0 kg/m^2. The most frequent diagnosis on admission was cardiovascular disease, followed by neurological disorders. Of the 124 patients, 52 patients (41.9%) were classified into the mobility disability group, and the remaining 72 patients



FIGURE| 1 Flowchart of patients in this study.

(58.1%) were classified into the no mobility disability group. We found that CFS score, the proportion of patients with neurological disorder, APACHE II score within 48 h of admission, and SOFA score were all significantly higher in the mobility disability group than in the no mobility disability group ($p < 0.001$, $p = 0.006$, $p = 0.026$ and $p = 0.043$). BMI on admission was significantly lower in the mobility disability group ($p = 0.049$). No significant differences were seen between groups with respect to age, sex, CCI, NRS2002 score, or treatment limitation. Body weight reduction was seen during hospitalization, but no significant difference between groups was apparent. LOS in the ICU or HCU was significantly longer in the mobility disability group than in the no mobility disability group ($p = 0.001$), but hospital LOS did not differ significantly between groups ($p = 0.096$). Barthel Index score at discharge and the percentage of patients discharged home or to the same nursing home were both higher in the no mobility disability group than in the mobility disability group ($p < 0.001$ each).

Treatments for patients are presented in Table 2. A total of 11 patients (8.9%) received invasive mechanical ventilation. Conventional oxygen therapy, the use of vasoactive agents, and continuous renal replacement therapy were performed for both groups, with no significant differences between groups.

ROC curve analysis was performed to identify the optimal cut-off for determining mobility disability at hospital discharge. Cut-off values of CFS, APACHE II, SOFA, and BMI, respectively, are presented in Table 3.

Prognostic factors affecting mobility disability in univariate survival analyses were identified as patients with neurological disease, CFS ≥5, APACHE II ≥14, SOFA ≥6, and BMI on admission <22.1 kg/m^2 (Table 4).

Multiple logistic regression analyses were performed to determine independent risk factors for mobility disability at hospital discharge (Table 5). CFS score ≥5 (odds ratio [OR] = 6.63, 95% confidence interval [CI] = 2.51–17.52; $p < 0.001$), SOFA score ≥6 (OR = 6.11, 95% CI = 1.57–23.77; $p = 0.009$) and neurological disorder as the main cause on admission (OR = 4.48, 95% CI = 1.52–13.20; $p = 0.006$) were independent, significant prognostic factors for mobility disability at discharge.

DISCUSSION

The present study evaluated the clinical characteristics and functional outcomes of patients ≥75 years old in a critical care setting. The main finding of our study was that 41.9% of patients could not walk independently at hospital discharge and that prognostic factors to detect mobility disability at hospital discharge were CFS ≥5 before hospitalization, SOFA ≥6 on admission, and neurological disorder diagnosed as the main cause of admission.

The prevalence of frailty among elderly patients was 10%–35% and the prevalence of frailty among individuals with critical illness has been reported as up to 43.1%.[16,17] In this study, 46.8% of our collected elderly patients showed CFS ≥5. Among these, we excluded elderly patients who could not walk unaided in various settings and remained in bed daily (mainly CFS = 7 or 8) before analysis, so we included elderly patients who were vulnerable or showed mild to moderate frailty (CFS = 1–6). This study showed that even mild to moderate frailty was predictive of mobility disability in elderly patients with critical illness. A rehabilitation intervention report showed that improved muscle function can prevent mobility disability in patients with CFS score ≥5.[18] Early detection of frailty using the CFS score and suitable rehabilitation interventions might help identify targets for intervention to reduce the functional decline of elderly patients.

The ratio of immobile patients with neurological disease was lower than that with other diseases at the time of discharge. Sustained physical dysfunctions such as paralysis, aphasia, or remaining cognitive dysfunctions might affect mobility disability. With reference to stroke, elderly patients with stroke show poor prognosis and are more likely to have disabilities and a low quality of life.[19] Suitable prediction of

TABLE 1 Baseline characteristics of the patients.

	All patients ($n = 124$)	No mobility disability ($n = 72$)	Mobility disability ($n = 52$)	
	Median [IQR] or number (%)	Median [IQR] or number (%)	Median [IQR] or number (%)	p-Value
Age (years)	83.0 [79.8–87.0]	83.0 [79.0–86.0]	84.0 [80.0–88.0]	0.256
Sex				
Male	76	50 (69.4%)	26 (50.0%)	0.098
Female	48	22 (30.6%)	26 (50.0%)	
BMI on admission (kg/m^2)	21.1 [18.9–23.4]	21.6 [19.2–23.7]	20.5 [18.2–21.9]	0.049*
CCI	5 [4–6]	5 [4–6]	5 [5–7]	0.098
CFS	4 [3–5]	4 [3–4]	5 [4–5]	<0.001*
Category of main cause on ICU or HCU admission				
Cardiovascular	30	21	9	0.191
Pulmonary	18	11	6	0.739
Neurological	25	8	17	0.006*
Gastrointestinal	15	12	3	0.119
Kidney, urinary, bladder	5	4	1	0.398
Metabolic	6	3	3	0.454
Trauma	13	4	9	0.070
Others	13	9	4	0.572
Sepsis				
Yes (%)	27 (21.8%)	19 (26.4%)	8 (15.4%)	0.213
Severity of Illness				
APACHE II	12 [9–16.3]	11 [8–14.3]	13 [11–18]	0.026*
SOFA	2 [1–4]	2 [1–3]	3 [1–6]	0.043*
Nutritional screening score				
NRS2002	4 [4–6]	4 [4–5]	4 [4–6]	0.176
Body weight change (kg)	−2.7 [−7.5 to 0]	−2.4 [−6.9 to 0]	−5.0 [−7.6 to 0]	0.307
Treatment limitation				
Do not attempt resuscitation	21 (16.9%)	12 (16.7%)	9 (17.3%)	1.000
ICU or HCU_LOS (days)	3.5 [2.0–6.8]	3.0 [2.0–4.5]	5.0 [3.0–10.0]	0.001*
Hospital_LOS (days)	14.0 [7.0–23.0]	13.0 [7.8–18.3]	17.0 [6.5–36.5]	0.096
Barthel Index at discharge	70 [40–95]	95 [65–95]	30 [0–60]	<0.001*
Disposition				
Home or same nursing home	75 (60.5%)	58 (80.6%)	17 (32.7%)	<0.001*
Hospital or other institute	49 (39.5%)	14 (19.4%)	35 (67.3%)	

Abbreviations: APACHE-II, Acute Physiology and Chronic Health Evaluation—II; BMI, body mass index; CCI, Charlson Comorbidity Index; CFS, Clinical Frailty Scale; ICU, intensive care unit; HCU, high care unit; LOS, length of stay; NRS2002, Nutritional Risk Screening 2002; SOFA, Sequential Organ Failure Assessment.

*$p < 0.05$.

physical function and ADL during the hospital stay, and the need for rehabilitation therapy are required to decide patient disposition at discharge. Conversely, cardiopulmonary and other diseases were not predictors of mobility disability in this study. Curable patients without neurological diseases during hospitalization, if they do not show frailty or SOFA ≥6, might be able to achieve their prehospital level of physical functioning more easily than neurological patients at discharge. Such objective information about individual prognostic factors should be shared by all medical staff, including doctors, nurses, rehabilitation therapists, and dietitians, to promote the management of patient mobility.

In this study, SOFA score was related to mobility disability at discharge. The recovery of the general condition in geriatric patients is slowed due to frailty or vulnerability, so the presence and severity of organ dysfunction as measured by SOFA score might affect short-term physical function in the elderly.

Previous studies have shown that the prevalence of death or new disability following critical illness was between 19.5% and 58.9% and age, illness severity, and admission diagnosis were predictive factors.[20,21] Although patients who died during hospitalization were excluded from the present study and the severity of illness in eligible patients was lower than

TABLE 2 Treatment in ICU or HCU.

	All patients ($n=124$)	No mobility disability ($n=72$)	Mobility disability ($n=52$)	p-Value
Respiratory support, n (%)				
Intubation	11 (8.9%)	3 (4.1%)	8 (15.4%)	0.051
COT	55 (44.4%)	33 (45.8%)	22 (42.3%)	0.836
Vasopressor use, n (%)	4 (3.2%)	2 (2.8%)	2 (3.8%)	1
CRRT, n (%)	4 (3.2%)	1 (1.4%)	3 (5.8%)	0.308

Abbreviations: COT, conventional oxygen therapy; CRRT, continuous renal replacement therapy; ICU, intensive care unit; HCU, high care unit.

TABLE 3 The optimal cut-off value of scales and scores for the prediction of mobility disability at hospital discharge.

		95% CI				
	AUC	Lower bound	Upper bound	Sensitivity	Specificity	Cut-off value
CFS	0.701	0.611	0.792	0.847	0.519	5
APACHEII	0.617	0.517	0.717	0.481	0.708	14
SOFA	0.606	0.504	0.707	0.931	0.269	6
BMI on admission	0.606	0.504	0.707	0.423	0.800	22.1

Abbreviations: APACHE-II, Acute Physiology and Chronic Health Evaluation—II; AUC, area under the curve; BMI, body mass index; CFS, Clinical Frailty Scale; SOFA, Sequential Organ Failure Assessment.

TABLE 4 Univariate analysis for the prediction of mobility disability at hospital discharge.

			95% CI		
	Cut-off value	Odds ratio	Lower bound	Upper bound	p-Value
Neurological disorder	Yes	3.84	1.40	11.39	0.006*
CFS	5	5.89	2.40	15.34	<0.001*
BMI on admission	<22.1	2.90	1.19	7.57	0.011*
APACHE II	14	2.23	1.00	5.06	0.039*
SOFA	6	4.87	1.51	18.67	0.004*

Abbreviations: APACHE-II, Acute Physiology and Chronic Health Evaluation—II; BMI, body mass index; CFS, Clinical Frailty Scale; SOFA, Sequential Organ Failure Assessment.

*$p<0.05$.

TABLE 5 Multivariate logistic regression analyss of the mobility disability at discharge.

			95% CI		
	Cut-off value	Odds ratio	Lower bound	Upper bound	p-Value
Neurological disorder	Yes	4.48	1.52	13.20	0.006*
CFS	5	6.63	2.51	17.52	<0.001*
BMI on admission	<22.1	1.86	0.70	4.96	0.211
APACHE II	14	0.87	0.32	2.37	0.790
SOFA	6	6.11	1.57	23.77	0.009*

Abbreviations: APACHE-II, Acute Physiology and Chronic Health Evaluation—II; BMI, body mass index; CFS, Clinical Frailty Scale; SOFA, Sequential Organ Failure Assessment.

*$p<0.05$.

in previous studies, the prevalence of patients with mobility disability was up to 41.9%. Reduced physiological reserves might affect recovery of physical condition among elderly patients.[22]

The average BMI among elderly Japanese (age ≥75 years) has been reported as $23.1 \pm 3.1\,kg/m^2$ and the percentage of obese elderly (BMI ≥30.0 kg/m^2) as only 3.1%.[23] Nonobese patients are more common in Asian countries (including Japan) than in Europe or North America.[24,25] Moreover, a previous report showed that patients with a lower BMI had significantly increased 28-day mortality compared to those with a normal or higher BMI in Japanese cohorts with severe

sepsis.[26,27] However, the optimal BMI cut-off to detect mobility disability among elderly individuals admitted to the ICU or HCU in Japan remains unclear. Given these points, BMI was handled as a continuous variable and univariate analysis was performed to detect suitable cut-offs.

Nutritional screening tools have been shown to predict mortality and nutritional support has been considered essential for improving mobility in frail patients.[19] However, the present study did not identify nutritional support as a predictor of mobility disability. Conversely, median body weight loss was about 2.7 kg during the hospital stay. These results showed that many elderly patients had nutritional problems on admission that lasted for the duration of hospitalization. Further research is required to show the role of nutritional management in the short term.

Several limitations in this study need to be recognized. First, this study was a retrospective investigation conducted on a small sample at a single medical center, so the findings may not be generalizable. Second, the primary endpoint was the outcome at hospital discharge, and a longer-term endpoint may be preferable. Third, although a nutritional assessment was used in this report, we should assess nutritional status combined with other nutritional screening tools for suitable assessment. Fourth, concerns were raised over the potential risk of overfitting in the present cohort. Frailty was shown as a predictive factor for immobility in other reports[8,9,28]; but a data-driven approach such as a *p*-value criteria was utilized to select variables in this study. This approach might represent a limitation for the generalizability of our findings.

CONCLUSION

CFS ≥5, neurological disease, and SOFA ≥6 appear to be useful to predict mobility disability among elderly patients ≥75 years old admitted to the ICU or intermittent care unit. Early identification of immobility risk might allow improvements in the prevalence of mobility disability among critically ill elderly patients.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ETHICS STATEMENT

Approval of the research protocol: This study was approved by the Research Ethics Committee at St. Marianna University School of Medicine (approval ID 5478).
Informed consent: We obtained informed consent from the patient.
Registry and registration no. of the study/trial: N/A.
Animal studies: N/A.

ORCID

Akiyoshi Nagatomi https://orcid.org/0009-0005-5918-4240

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