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Predictors of independent walking at hospital discharge in elderly heart failure patients

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Elderly heart failure (HF) patients often experience reduced activities of daily living (ADL) following hospital admission; thus, interventions performed from initial admission to improve ADL are important [1]. The ability to perform ADL in these patients is an important factor relating to re-admission rates and mortality [2] and is measured by the Functional Independence Measure (FIM) and other assessments [3]. In elderly HF inpatients, pre-hospital ambulation, comorbidity and severity are associated with ADL at discharge [1,4]. However, the number of elderly HF patients in Japan using long-term care insurance (LTCI), which supports elderly people with physical disability, has increased. Applicants for LTCI are classified into six levels according to degree of disability. If physical and cognitive functions are severely compromised, the LTCI level is high and relates to low performance of ADL [5]. It is unclear whether ADL of elderly inpatients with HF at discharge can be predicted based on the LTCI level and other factors at admission because few studies have investigated ADL prognosis in such patients at admission. We hypothesized that use of LTCI would highly affect ADL at discharge compared to other factors. Therefore, we performed a retrospective longitudinal study to investigate the predictors for ADL at discharge in elderly inpatients with HF.

The present study comprised 502 consecutive acute HF patients who underwent rehabilitation at one acute-care hospital from August 2011 to March 2014. Patient inclusion criteria included brain natriuretic peptide (BNP) ≥ 18.4 pg/mL and symptoms such as dyspnea and fatigue at rest or during physical activity based on New York Heart Association (NYHA) functional class definitions indicating acute HF. Exclusion criteria included patients with acute coronary syndrome and right HF patients who could not walk independently without an assistive device.

Patient characteristics were evaluated by retrospective review of medical records. They included age, sex, body mass index, NYHA class, left ventricular ejection fraction, BNP, hemoglobin, estimated glomerular filtration rate (eGFR), acute management, comorbidity, LTCI grade, medications on admission, and cognitive function [6]. Mobility and ADL were evaluated with the Rivermead Mobility Index (RMI) [7] and FIM, respectively. All measurements were performed within two days after hospital admission.

The Kokura Rehabilitation College institutional review committee approved this study (approval no. 2601), and informed consent was obtained from each participant.

Results are expressed as mean $\pm$ standard deviation (SD). Patients were divided into two groups according to the FIM locomotion item score at discharge: independence group (locomotion score ≥ 7 points) and non-independence group (locomotion score ≤ 6 points). Independent walking was defined as a FIM locomotion score of ≥ 7 points [2]. Unpaired *t*-test, Mann-Whitney U test, and chi-square test were used to compare patient characteristics between groups.

Logistic regression analysis was conducted using the FIM locomotion score to determine whether any differences existed in clinical characteristics to identify factors predicting independent walking at discharge. Stepwise analysis was performed for factors showing significant difference in the clinical characteristics of the two groups (independent variables) and the FIM locomotion score (dependent variable). A *P* value < 0.05 indicated statistical significance. Statistical analyses were performed with IBM SPSS 22.0 J (IBM SPSS Japan, Inc., Tokyo, Japan).

Of the 502 patients, 148 met the inclusion criteria and were divided into the independence group (n = 55) and non-independence group (n = 93). There were no significant differences between the two groups except in age, sex, hemoglobin, eGFR, LTCI, cognitive function, RMI, and FIM (Table 1).

The results of the stepwise logistic regression analysis (Table 2) indicated that non-use of LTCI and high cognitive function at admission were significant independent predictive factors for independent walking at discharge.

This is the first study, to our knowledge, to report that compared to other factors, non-use of LTCI and high cognitive function on admission were significant predictive factors, with high odds ratios, of independent walking at discharge in elderly patients with HF. These results are partly compatible with findings in Wang et al. [4] and Kamo et al. [8].

Elderly patients using LTCI have reduced physical function and ADL compared with healthy elderly [8,9], and elderly HF patients with low physical function and ADL before hospitalization have reduced ADL at discharge [1]. Thus, elderly HF inpatients with LTCI whose physical function and ADL were low before hospitalization might also have reduced ADL at discharge.

Cognitive decline at admission can inhibit the progress of rehabilitation due to decreased motivation. Cognitive function and physical activity are associated in healthy elderly [4]. Thus, a decrease in cognitive function might make recovery of ADL difficult due to low patient motivation and physical activity.

The odds ratio for use of LTCI was higher than that for cognitive function. This difference can be explained by the main reason a patient might have LTCI, i.e., that he/she suffers from neurological disease, frailty, osteoarticular disease, or dementia [9]. Physical functions such as walking and ADL in the elderly

with LTCI, excluding those with severe dementia, are related [10]. The most frequent reason for having LTCI in elderly people > 80 years old is frailty. It is difficult for frail elderly people to obtain functional recovery after hospitalization [11]. Therefore, the low physical function of the patients in the non-independence group, excluding those with dementia, might be a result of the comorbidity of frailty, which affected independent walking at discharge.

Contrastingly, disease severity and mobility were not extracted as predictive factors of independent walking at discharge. Treatment of acute HF with rest is the top priority for life-saving [1]; thus, patients generally experience a lack of mobility in the first few hospital days after admission. However, even in patients with severe disease and low mobility at admission, the factors of non-use of LTCI and good cognitive function before admission indicate the high possibility for improving the odds for and predicting independent walking at discharge.

As limitations, this was a single-site study with small sample size, which reduce the generalizability of the results. Although we consider it important to investigate physical and cognitive function and ADL in elderly HF patients using LTCI before admission, we could not investigate physical function and reasons for the use of LTCI, nor could we investigate the deaths of patients admitted with HF.

In conclusion, patient mobility and ADL on admission may have little effect on ADL at discharge. Rather, high cognitive function and non-use of LTCI at admission may be useful factors for predicting independent walking at discharge in elderly patients with HF.

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Table 1 Clinical characteristics of the patients

	Total n = 148	Independence group n = 55	Non- independence group n = 93	<i>t</i> or χ^2 value	<i>P</i> value
Age (yrs)	82.4 ± 6.7	79.3 ± 5.9	84.2 ± 6.5	-4.60 ^a	< 0.001
Sex (male, %)	49.3	60.0	43.0	3.99	0.046
BMI (kg/m ²)	21.1 ± 3.5	21.6 ± 3.2	20.7 ± 3.6	1.45 ^a	0.149
Clinical and biochemical parameters					
NYHA class (%)				3.76	0.289
NYHA I	1.4	2.0	1.1		
NYHA II	14.9	20.0	11.8		
NYHA III	39.9	43.6	37.6		
NYHA IV	43.9	34.5	49.5		
LVEF (%)	46.6 ± 16.2	44.8 ± 15.9	47.6 ± 16.3	-1.00 ^a	0.319
BNP (pg/mL)	946.1 ± 702.1	817.4 ± 610.2	1022.1 ± 743.9	-1.73 ^a	0.087
Hb (g/dL)	11.3 ± 2.5	12.5 ± 2.1	10.6 ± 2.5	4.73 ^a	< 0.001
eGFR (ml/min/1.73 m ²)	44.1 ± 19.9	52.2 ± 16.7	39.8 ± 20.4	3.95 ^a	< 0.001
Acute management (%)	20.9	16.4	23.7	1.11	0.292
Comorbidity (%)					
Hypertension	89.2	92.7	87.1	1.14	0.286
Diabetes	34.5	30.9	37.0	0.56	0.456
Dyslipidemia	40.5	38.2	41.9	0.20	0.653
Smoking history	29.7	36.4	25.8	1.84	0.175
Ischemic heart disease	53.4	55.6	52.7	0.11	0.737
Valvular disease	38.5	35.2	40.9	0.46	0.496
Atrial fibrillation	36.5	42.6	33.3	1.26	0.262
Pacemaker	4.7	3.7	5.4	0.21	0.491
Heart surgery	3.4	3.7	3.2	0.02	0.878
Orthopedic disease	37.2	29.1	41.9	2.44	0.118
Neurological disease	21.6	18.2	23.7	0.61	0.434
Respiratory disease	18.2	14.5	20.4	0.80	0.370
LTCI level (%)				30.49	< 0.001
Non-care	66.9	94.6	50.5		
Support level 1-2	12.8	1.8	19.4		

Care level 1	13.5	1.8	20.4		
Care level 2	4.7	1.8	6.5		
Care level 3	1.4	0	2.1		
Care level 4	0.7	0	1.1		
Care level 5	0	0	0		
Medication					
Diuretic	95.9	94.5	96.8	0.44	0.507
β-Blockers	48.6	54.5	45.2	1.22	0.270
ACEI/ARB	36.5	32.7	38.7	0.53	0.465
Cognitive function, mobility and ADL					
Cognitive function	3.1 ± 1.1	2.5 ± 0.9	3.4 ± 1.1	-4.55 ^a	< 0.001
RMI	2.3 ± 1.9	3.0 ± 2.2	1.9 ± 1.5	3.71 ^a	< 0.001
FIM	62.1 ± 22.1	71.1 ± 21.5	56.7 ± 21.5	4.06 ^a	< 0.001

Values denote means ± standard deviation unless specified otherwise.

BMI: body mass index, NYHA: New York Heart Association, LVEF: left ventricular ejection fraction, BNP: brain natriuretic peptide, Hb: hemoglobin, eGFR: estimated glomerular filtration rate, LTCI: long-term care insurance, ACEI: angiotensin converting enzyme inhibitor, ARB: angiotensin-receptor blocker, ADL: activities of daily living, RMI: Rivermead Mobility Index, FIM: Functional Independence Measure.

^a t value.

Table 2 Logistic regression analysis for prediction of independent walking at discharge

	β	Odds ratio	95% CI	<i>P</i> value
LTCI level	1.524	4.591	2.05–10.282	< 0.001
Cognitive function	0.771	2.163	1.442–3.243	< 0.001

LTCI: long-term care insurance.