The Changes in Frailty and Death within Six Months of Discharge in Heart Failure Patients 80 Years and Older

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Aim : The prognostic impact of frailty in patients with heart failure (HF) is of interest because the cascade of frailty and HF accelerates deterioration. However, few studies have examined the deterioration of frailty in older HF patients. Therefore, we examined changes in frailty and death within six months after discharge from the hospital to clarify the reasons for the poor prognoses and to explore risk factors that influence each of them.

Methods : This was a single-center prospective cohort study of hospitalized HF patients aged 80≧ years. Frailty was measured using the Clinical Frailty Scale (CFS). Reasons for poor prognosis were examined, and discharge attributes were compared between the CFS worsening and death groups and the CFS maintaining/improving group at six months after discharge.

Results : The subjects consisted of 96 patients (89.3±4.6 years), and their CFS at six months was that 68 had improved or maintained, 12 had worsened, 14 had died, and two were missing. Reasons for worsening frailty included worsening cardiovascular disease and comorbidities, fall fracture, and dementia. Risk factors that could influence mortality (e.g., BNP, hemoglobin, CFS) were similar to previous studies, and few risk factors were found that could influence frailty deterioration (e.g., ACE-I/ARB not prescribed).

Conclusions : Some older HF patients experience worsening of frailty and death after hospital discharge. However, the potential factors associated with frailty deterioration are unknown, suggesting that treatment and care approaches should be tailored to individual conditions such as cardiovascular diseases, comorbidities, fall risk, and dementia. *Shinshu Med J 71 : 53—61, 2023*

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Key words : frailty, heart failure, prognosis, geriatrics, older adults

I Introduction

Frailty is a condition associated with aging and is characterized by the reduced ability to cope with daily or acute stressors due to decreased physiologic reserve and function across multiple organs[1)]. In heart failure (HF) patients, the prognostic impact of frailty is of interest because the cascade of frailty and HF accelerates deterioration.

A meta-analysis of Uchmanowicz[2)] showed that the presence of frailty in HF increased the hazards of all-cause death and HF-related hospitalization by means of 48 % and 40 %, respectively. Kanenawa[3)] further showed that severe frailty was independently associated with all-cause death and HF-related hospitalizations among 596 discharged patients (mean age 76.6 ± 10.1 years).

It has been suggested that risk factors affecting death and re-hospitalization among older HF patients may differ from those in younger patients[4)5)]. However, to our knowledge, no report has examined the

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prognostic impact of severity of frailty in the elderly without excluding patients with cognitive or physical disabilities.

To our knowledge, there have also been no reports examining changes in frailty or reasons for worsening frailty in these patients after discharge from the hospital. Identifying the relationship between frailty and prognosis, as well as the reasons for worsening frailty, would be beneficial in the patient's treatment and care.

Therefore, in the present study, we examined risk factors affecting prognosis, including worsening frailty and death, and reasons for worsening frailty and death in HF patients aged 80 years and older.

While there is still no consensus on a gold standard for frailty assessment, we used the Clinical Frailty Scale (CFS)[6)7)] that considers frailty to be an accumulation of age-related deficits. In the CFS, a medical professional evaluates a patient's comorbidities and functional and cognitive status and grades the patient's overall condition on a 9-point stage[7)]. The CFS was implemented in this study because it is widely used to measure health outcomes in geriatric medicine and cardiology units[8)] due to its simplicity and good sensitivity for frailty detection[9)].

The purpose of this study was to examine CFS changes and death in HF patients aged 80 years and older between discharge and 6 months later, to determine reasons for worsening frailty and death and to explore risk factors that influence worsening frailty and death.

Ⅱ Methods

A Study design and participants

A prospective cohort study was conducted on consecutive patients aged 80 years or older who were admitted for HF to the cardiology department of a hospital in Nagano Prefecture, Japan. This was a regional core hospital that provided percutaneous coronary intervention and did not perform cardiac surgery but provided medical treatment and cardiac rehabilitation according to the guidelines. HF was diagnosed by cardiologists using the Framingham criteria. We conducted recruitment for the study from February 2020 to August 2021. Exclusion criteria were as follows : (1) death in the hospital, (2) development of a serious illness other than HF during hospitalization, and (3) refusal to participate in the study. We defined discharge from the hospital as the baseline and followed up with the patients six months after discharge. We conducted the study in accordance with the Declaration of Helsinki and with the approval of the Shinshu University Ethics Committee (approval numbers : 4648, 5039) and the participating hospitals.

B Variables

We collected data from hospital medical records. Baseline clinical data included age, gender, history of HF hospitalization, length of hospitalization, cause of HF, comorbidities, and discharge prescriptions. Data at discharge included New York Heart Association (NYHA) classification, B-type natriuretic peptide (BNP), left ventricular ejection fraction (LVEF), body mass index (BMI), hemoglobin (Hb), albumin (Alb), estimated glomerular filtration rate (e-GFR), and Barthel Index (BI).

CFS was assessed by an occupational therapist. Since the CFS stages were revised in September 2020, the data from the old stages collected prior to that date were converted to the revised stages. Because many clinical studies consider CFS stage 5 or higher to be frail, this criterion was used in this study[8)].

C Follow up

We examined whether the CFS stage that the HF patient was in improved, maintained, or worsened between discharge and 6 months after discharge. CFS assessment at 6 months after discharge was performed by an occupational therapist who evaluated the patients at discharge through interviews in the outpatient clinic, by telephone, and by mail survey. When the CFS stage worsened, whether there were any rehospitalizations or irregular visits due to the occurrence of a new disease or worsening of an existing disease was examined by analyzing the medical records and interviewing patients/families. If yes, the main disease was used as the reason for worsening frailty. If a patient died within six months of discharge, it was confirmed either in the

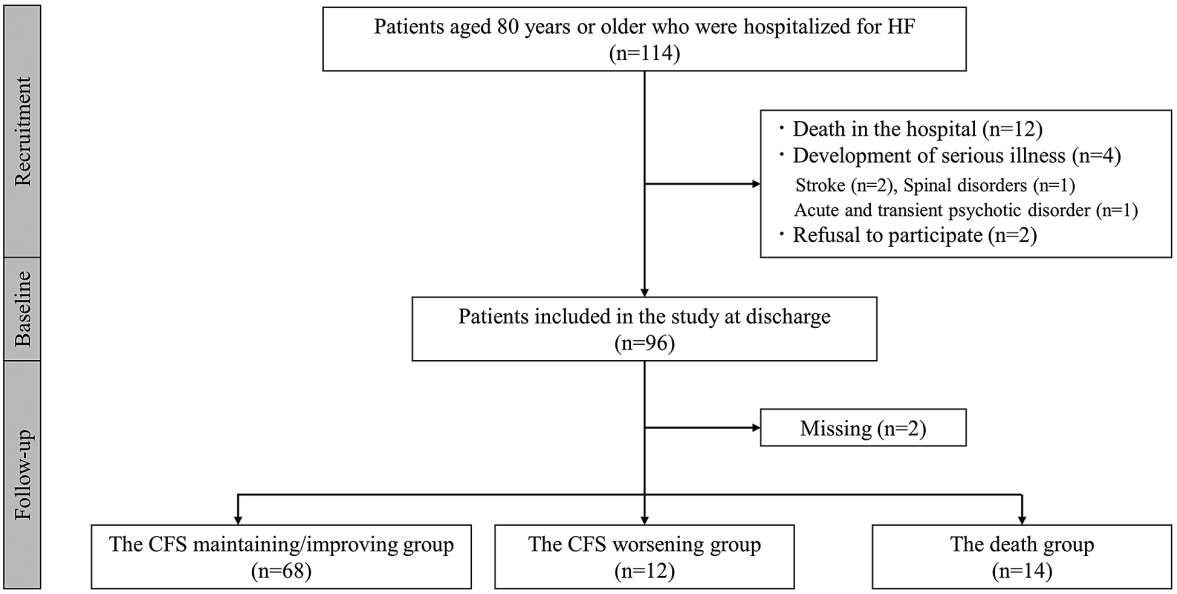


Fig. 1　Study population flow chart

patient's records or by telephone.

D　Statistical analysis

Baseline characteristics of patients in the CFS worsening and death groups at 6 months after discharge were compared with those in the CFS maintaining/improving group. Sub-analyses were performed as appropriate for any characteristics that differed significantly.

We presented continuous data as means and standard deviations (SD) for normally distributed variables and as medians and interquartile ranges (IQR) for variables with non-normal distributions. We conducted the Shapiro-Wilk test to determine if each variable was normally distributed. We expressed categorical data as numbers and percentages. To evaluate group differences, we conducted Student's t-test or Mann-Whitney U test for continuous data and the Chi-squared test or Fisher's exact test for categorical data. The Bonferroni post-hoc test was used for multiple comparisons. We analyzed the data using SPSS version 28 (IBM, Armonk, NY, USA) and R version 4. 1. 2 (R Core Team 2017, Vienna, Austria). It was a two-tailed test, and we considered p-values <0.05 statistically significant.

Ⅲ　Results

Among 114 older adult patients admitted for HF, we excluded 12 patients due to in-hospital death, four due to the development of serious non-HF symptoms during hospitalization, and two due to their refusal to participate ; 96 were followed up **(Fig. 1)**.

The 96 patients' characteristics at baseline are presented in **Table 1**. Overall, patients' mean age ± SD was 89.3 ± 4.6 years, and 52 (54.0 %) were male. The first HF hospitalization was noted in 47 (49.0 %) patients, and the median [IQR] of the length of hospitalization was 19.5 [15.0-29.0] days. Patients' comorbidities included atrial fibrillation 70 (72.9 %), cognitive disorder 46 (47.9 %), sleep apnea syndrome 28 (29.2 %), and diabetes mellitus (DM) 26 (27.1 %). Prescription at discharge included a diuretic, 67 (69.8 %), and an angiotensin converting enzyme inhibitor/angiotensin Ⅱ receptor blocker (ACE-I/ARB), 57 (59.4 %). NYHA classification was Ⅱ in 12 (12.5 %) of patients, Ⅲ in 75 (78.1 %) of patients, and Ⅳ in 9 (9.4 %) of patients. The median [IQR] of BNP was 255.8 [134.2-506.1] pg/ml. Further, 58 (60.4 %) patients had an LVEF ≧50 %. The mean ± SD of Hb and Alb were 11.6 ± 2.2 g/dl and 3.4 ± 0.5 g/dl, respectively. The median [IQR] of e-GFR and BI were 37.0 [26.0-47.0] ml/min/1.73m^2 and 87.5 [65.0-100.0], respectively. At discharge, CFS stage of the patients ranged from 4 to 8. The number of patients with frailty (CFS≧5) was 91 (94.8 %).

Table 1　Baseline patient characteristics (n＝96)

Age (years)	89.3±4.6	Conditions at discharge	
Male gender, n(%)	52 (54.2 %)	NYHA class, n(%) Ⅱ	12 (12.5 %)
First HF hospitalization, n(%)	47 (49.0 %)	Ⅲ	75 (78.1 %)
Length of hospitalization(days)	19.5 [15.0–29.0]	Ⅳ	9 (9.4 %)
Cause of HF, n(%)		BNP (pg/ml)	255.8 [134.2–506.1]
Valvular heart disease†	75 (78.1 %)	LVEF, n(%) ≧50 %	58 (60.4 %)
Hypertension‡	62 (64.6 %)	41–49 %	19 (19.8 %)
Ischemic heart disease‡	18 (18.8 %)	≦40 %	19 (19.8 %)
Other heart diseases§	9 (9.4 %)	BMI (kg/m^2)	20.0 [18.1–22.3]
Comorbidities, n(%)		Hemoglobin (g/dl)	11.6±2.2
Atrial fibrillation‡	70 (72.9 %)	Albumin (g/dl)	3.4±0.5
Cognitive disorder¶	46 (48.4 %)	e-GFR (ml/min/1.73m^2)	37.0 [26.0–47.0]
Sleep apnea syndrome‡	28 (29.2 %)	Barthel Index	87.5 [65.0–100.0]
Diabetes mellitus‡	26 (27.1 %)	CFS stage 4	5 (5.2 %)
COPD/Asthma‡	17 (17.7 %)	5	30 (31.3 %)
Prescriptions at discharge, n(%)		6	41 (42.7 %)
Diuretic	67 (69.8 %)	7	9 (9.4 %)
ACE-I/ARB	57 (59.4 %)	8	11 (11.5 %)
MRA	52 (54.2 %)	Presence of frailty (CFS≧5)	91 (94.8 %)
β blocker	39 (40.6 %)		
Digoxin	10 (10.4 %)		
SGLT2-I	7 (7.3 %)		

Data are presented as mean ± standard deviation, median [interquartile range] or n(%).

† Yes, in the presence of moderate or severe valvular disease.

‡ Yes, in the presence of diagnosis.

§ Cardiomyopathy, invasive heart disease, ventricular septal defect, sarcoidosis, amyloidosis.

¶ Mini-Mental State Examination ＜24 or Clinical Dementia Rating 0.5＞as measured during hospitalization.

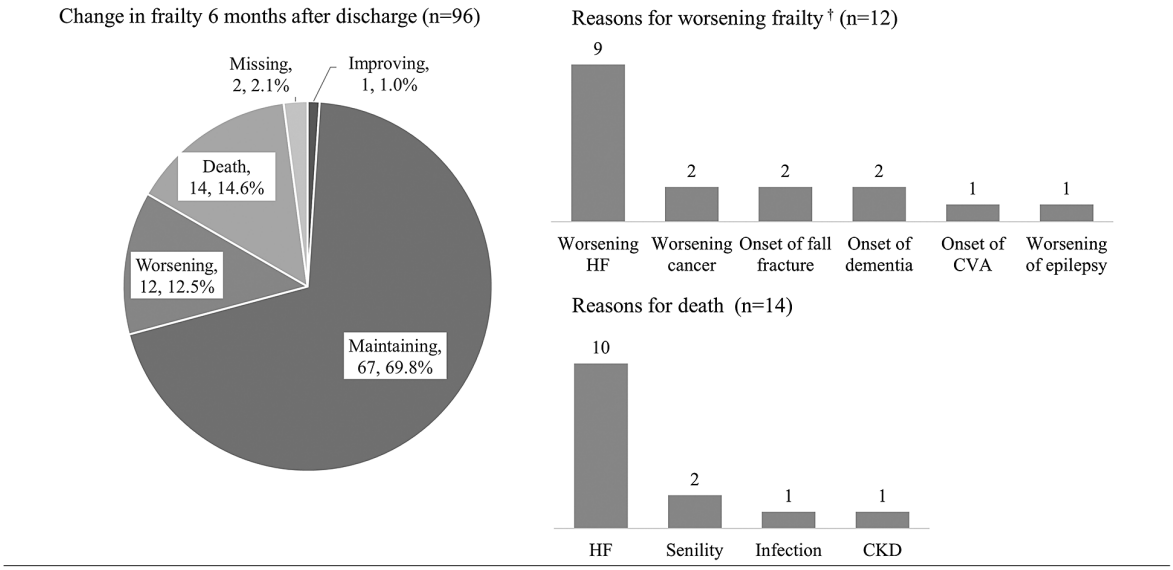
Abbreviations : HF, heart failure ; COPD, chronic obstructive pulmonary disease ; ACE-I, angiotensin-converting-enzyme inhibitor ; ARB, angiotensin Ⅱ receptor blocker ; MRA, mineralocorticoid receptor antagonist ; SGLT2-I, sodium-glucose cotransporter 2 inhibitors ; NYHA, New York Heart Association ; BNP, B-type natriuretic peptide ; LVEF, left ventricular ejection fraction ; BMI, body mass index ; e-GFR, estimated glomerular filtration rate ; CFS, clinical frailty scale.

Change in CFS stage 6 months after discharge was as follows : one patient (1.0 %) improved, 67 patients (69.8 %) maintained, 12 patients (12.5 %) exhibited worsening, 14 patients (14.6 %) died, and 2 patients had missing data (2.1 %) **(Fig. 2)**. The reasons for worsening frailty, in multiple responses and in descending order, were as follows : worsening HF (n＝9), worsening cancer (n＝2), onset of fall fracture (n＝2), onset of dementia (n＝2), onset of cerebrovascular disease (CVA) (n＝1), and worsening epilepsy (n＝1). The reasons for death were worsening HF (n＝10), senility (n＝2), infection (n＝1), and chronic kidney disease (CKD) (n＝1).

Compared to the CFS maintaining/improving group, the CFS worsening group had fewer patients with DM ($p<0.05$) and fewer patients prescribed ACE-I/ARBs ($p<0.05$) **(Table 2)**.

Compared to the CFS maintaining/improving group, the death group had fewer first HF hospitalizations ($p<0.01$), more severe NYHA ($p<0.01$), higher BNP ($p<0.05$), lower Hb ($p<0.01$), lower Alb ($p<0.01$), lower e-GFR ($p<0.05$), lower BI ($p<0.01$), and more severe CFS ($p<0.01$) **(Table 2)**.

A sub-analysis was performed to examine confounding factors for the two attributes, i.e., DM and prescribed ACE-I/ARBs that were significantly different between the CFS worsening group and the CFS maintaining/improving group **(Table 3)**. The patients who were prescribed ACE-I/ARB had shorter length of hospitalization ($p<0.05$), higher BMI ($p<0.01$), and higher BI ($p<0.01$) than those who were not prescribed ACE-I/ARB. The patients with DM



† Multiple answers
Abbreviation: CFS, clinical frailty scale; HF, heart failure; CVA, cerebrovascular disease; CKD, chronic kidney disease.

Fig. 2 Change in CFS stage 6 months after discharge and reasons for worsening frailty and death

had higher BMI than those without DM ($p < 0.05$).

Ⅳ Discussion

A Mortality and risk factors for death

In this study, the all-cause mortality at 6 months after discharge was 14.9 %, and the reasons for death were HF, senility, infection, and CKD, which seemed to reflect the actual situation in a regional core hospital that did not perform cardiac surgery. The mortality was higher than 7.9 % in Kanenawa's[3] study (mean age 76.6 ± 10.1 years, n = 596) and 8.5 % in Suzuki's[10] study (mean age 80 years, n = 504) ; these studies were conducted in hospitals where cardiac surgery was performed, but was lower than those of Obata's[11] study (mean age 88.3 ± 5.1 years, n = 372) conducted in non-operative hospitals. Post-discharge mortality varies according to the characteristics of the hospitals studied. In Kanenawa's study, 43.4 % of the patients had CFS 5 or higher, with 94.8 % in the present study, and in Suzuki's study, 19 % had NYHA Ⅲ and Ⅳ, with 87.5 % in the present study, suggesting that the high mortality in the present study was due to exclusion of patients in good condition who were eligible for cardiac surgery. However, the median BI in Obata's study was 65, with 87.5 in the present study, suggesting that there were more patients in relatively good condition among non-surgical hospitals.

In this study, attributes that may influence all-cause death include no first HF hospitalization, BNP, NYHA, Hb, Alb, e-GFR, BI, and CFS (all data at the time of discharge). In addition to history of HF hospitalization and NYHA, which are variables that reflect the severity of HF, systematic reviews, meta-analyses, and large cohort studies have shown that BNP[12], anemia[13], Alb[14], renal function[15], ADL[11], and frailty[2] are risk factors for death. The present study showed similar trends to these results.

B Worsening frailty rate and risk factors

In this study, 12.5 % of the patients had worsening frailty 6 months after discharge from the hospital, and they visited the hospital irregularly or were new patients at the hospital due to worsening HF, onset of CVA, worsening of comorbidities, fall fracture, and onset of dementia. Yang[16] reviewed and discussed the impact of dementia on the prognosis of HF patients, including pathophysiological reasons, and pointed out the need to focus on dementia in the treatment and care of HF patients. In this study, HF patients with worsening frailty developed dementia after discharge from the hospital, supporting Yang's point.

No previous studies have examined risk factors for worsening frailty, but a similar study examined risk factors for rehospitalization. They have shown that

Table 2 Comparison of baseline attributes between the CFS maintaining/improving and the CFS worsening or the death groups

Variables	Maintaining/Improving (n = 68)	Worsening (n = 12)	Death (n = 14)
Age (years)	88.7 ± 4.4	90.3 ± 3.6	90.6 ± 5.9
Male gender, n(%)	38 (67.9 %)	4 (33.3 %)	9 (64.0 %)
First HF hospitalization, n(%)	40 (58.8 %)	4 (33.3 %)	3 (14.0 %)**
Length of hospitalization (days)	19.5 [15.0–28.0]	15.5 [12.5–22.8]	29.5 [12.8–53.0]
Valvular heart disease, n(%)	54 (79.4 %)	9 (75.0 %)	10 (71.4 %)
Hypertension, n(%)	45 (66.2 %)	9 (75.0 %)	8 (57.1 %)
Ischemic heart disease, n(%)	14 (20.6 %)	1 (8.3 %)	3 (21.4 %)
Atrial fibrillation, n(%)	47 (69.1 %)	9 (75.0 %)	12 (85.7 %)
Cognitive disorder, n(%)	35 (51.5 %)	3 (25.0 %)	6 (46.2 %)
Sleep apnea syndrome, n(%)	15 (22.1 %)	6 (50.0 %)	7 (50.0 %)
Diabetes mellitus, n(%)	24 (35.3 %)	0 (0.0 %)*	2 (14.0 %)
COPD/Asthma, n(%)	15 (22.1 %)	1 (8.3 %)	1 (8.3 %)
Diuretic, n(%)	42 (61.8 %)	11 (91.7 %)	13 (92.9 %)
ACE-I/ARB, n(%)	47 (69.1 %)	3 (25.0 %)*	6 (43.0 %)
MRA, n(%)	34 (50.0 %)	7 (58.3 %)	9 (64.3 %)
β blocker, n(%)	30 (44.1 %)	6 (50.0 %)	3 (21.4 %)
Digoxin, n(%)	8 (11.8 %)	2 (16.7 %)	0 (0.0 %)
SGLT2-I, n(%)	5 (7.4 %)	0 (0.0 %)	2 (14.3 %)
NYHA, n(%) Ⅱ	10 (14.7 %)	2 (16.7 %)	0 (0.0 %)]**
Ⅲ	57 (83.8 %)	9 (75.0 %)	6 (43.0 %)
Ⅳ	1 (1.5 %)	1 (8.3 %)	8 (57.0 %)]
BNP(pg/ml)	221.0 [134.5–434.8]	228.5 [90.0–458.8]	590.1 [239.5–1385.5]*
LVEF50%≧, n(%)	41 (60.3 %)	9 (75.0 %)	6 (42.9 %)
BMI (kg/m^2)	19.9 [18.2–21.9]	19.4 [18.1–21.5]	20.2 [17.7–23.2]
Hemoglobin(g/dl)	11.9 ± 2.0	11.9 ± 1.9	9.5 ± 2.1**
Albumin(g/dl)	3.5 ± 0.5	3.7 ± 0.4	2.8 ± 0.5**
e-GFR(mL/min/1.73m^2)	39.0 [28.3–49.0]	33.5 [25.3–43.0]	24.0 [20.3–39.5]*
Barthel Index	90.0 [66.3–100.0]	87.5 [75.0–100.0]	32.5 [5.0–100.0]**
CFS, n(%) 4-6	59 (86.8 %)	12 (100.0 %)	5 (35.7 %)]**
7-8	9 (13.2 %)	0 (0.0 %)	9 (64.3 %)]

Data are presented as mean ± standard deviation, median [interquartle range] or n(%).
Bonferroni post-hoc test between the CFS maintained/improved vs. the CFS worsened groups, and between the CFS maintained/improved vs. the mortality groups.
*$p<0.05$; vs. Maintained/Improved group. **$p<0.01$; vs. Maintained/Improved group.
Abbreviations : CFS, clinical frailty scale ; HF, heart failure ; COPD, chronic obstructive pulmonary disease ; ACE-I, angiotensin-converting-enzyme inhibitor ; ARB, angiotensin Ⅱ receptor blocker ; MRA, mineralocorticoid receptor antagonist ; SGLT2-I, sodium-glucose cotransporter 2 inhibitors ; NYHA, New York Heart Association ; BNP, B-type natriuretic peptide ; LVEF, left ventricular ejection fraction ; BMI, body mass index ; e-GFR, estimated glomerular filtration rate.

the risk ratio for each factor of rehospitalization tends to be lower in older adults than in younger adults and that risk factors for rehospitalization are less detectable than those for death at any age[4)5)17)18)]. The present study also found lower risk ratios and fewer significant risk factors for worsening frailty than for death.

In this study, attributes that may influence wors-

Table 3 Sub-analysis, comparison of baseline attributes with and without ACE-I/ARB and with and without diabetes mellitus

	ACE-I/ARB		Diabetes mellitus	
	+	−	+	−
Variables	(n = 50)	(n = 30)	(n = 24)	(n = 56)
Age (years)	88.9 ± 4.0	89.1 ± 4.9	87.9 ± 4.0	89.4 ± 4.4
Male gender, n(%)	34 (59.6 %)	18 (46.2 %)	15 (62.5 %)	27 (48.2 %)
First HF hospitalization, n(%)	32 (56.1 %)	15 (38.5 %)	15 (62.5 %)	29 (51.8 %)
Length of hospitalization (days)	18.0 [14.8-24.0]	22.5 [14.8-33.3] *	18.0 [15.0-24.0]	19.5 [14.3-29.5]
Valvular heart disease, n(%)	38 (76.0 %)	25 (83.3 %)	19 (79.2 %)	44 (78.6 %)
Hypertension, n(%)	36 (72.0 %)	18 (60.0 %)	16 (66.7 %)	38 (67.9 %)
Ischemic heart disease, n(%)	10 (20.0 %)	5 (16.7 %)	4 (16.7 %)	11 (19.6 %)
Atrial fibrillation, n(%)	35 (70.0 %)	21 (70.0 %)	16 (66.7 %)	40 (71.4 %)
Cognitive disorder, n(%)	25 (50.0 %)	13 (43.3 %)	11 (45.8 %)	27 (48.2 %)
Sleep apnea syndrome, n(%)	13 (26.0 %)	8 (26.7 %)	6 (25.0 %)	15 (26.8 %)
Diabetes mellitus, n(%)	18 (36.0 %)	6 (20.0 %)		
COPD/Asthma, n(%)	12 (24.0 %)	4 (13.3 %)	4 (16.7 %)	12 (21.4 %)
Diuretic, n(%)	32 (64.0 %)	21 (70.0 %)	12 (50.0 %)	41 (73.2 %)
ACE-I/ARB, n(%)			18 (75.0 %)	32 (57.1 %)
MRA, n(%)	26 (52.0 %)	15 (50.0 %)	12 (50.0 %)	29 (51.8 %)
β blocker, n(%)	20 (40.0 %)	16 (53.3 %)	10 (41.7 %)	26 (46.4 %)
Digoxin, n(%)	5 (10.0 %)	5 (16.7 %)	4 (16.7 %)	6 (10.7 %)
SGLT2-I, n(%)	4 (8.0 %)	1 (3.3 %)	3 (12.5 %)	2 (3.6 %)
NYHA, n(%) Ⅱ	10 (20.0 %)	2 (6.7 %)	3 (12.5 %)	9 (16.1 %)
Ⅲ	40 (80.0 %)	27 (90.0 %)	21 (87.5 %)	46 (82.1 %)
Ⅳ	0 (0.0 %)	1 (3.3 %)	0 (0.0 %)	1 (1.8 %)
BNP(pg/ml)	210.7 [118.0-395.7]	261.4 [133.2-484.7]	235.3 [104.1-501.5]	225.4 [134.2-436.5]
LVEF50%≧, n(%)	30 (60.0 %)	20 (66.7 %)	13 (54.2 %)	37 (66.1 %)
BMI (kg/m^2)	20.7 [18.6-23.2]	18.6 [17.5-20.4] **	21.5 [18.6-23.2]	19.6 [18.0-20.9] *
Hemoglobin(g/dl)	12.0 ± 1.8	11.8 ± 2.3	12.5 ± 4.6	11.7 ± 2.1
Albumin(g/dl)	3.6 ± 0.4	3.5 ± 0.5	3.5 ± 0.5	3.6 ± 0.3
e-GFR(mL/min/1.73m^2)	37.0 [26.0-45.3]	40.5 [33.3-50.3]	35.0 [28.5-46.8]	39.0 [26.3-49.0]
Barthel Index	92.5 [80.0-100.0]	75.0 [57.5-91.3] **	92.5 [80.0-100.0]	90.0 [65.0-100.0]
CFS, n(%) 4-6	46 (92.0 %)	25 (83.3 %)	24 (100.0 %)	47 (86.0 %)
7-8	4 (8.0 %)	5 (16.7 %)	0 (0.0 %)	9 (16.0 %)

Data are presented as mean ± standard deviation, median [interquartile range] or n(%).

*p＜0.05 ; Presence vs. Absence. **p＜0.01 ; Presence vs. Absence.

Abbreviations : ACE-I, angiotensin-converting-enzyme inhibitor ; ARB, angiotensin Ⅱ receptor blocker ; HF, heart failure ; COPD, chronic obstructive pulmonary disease ; MRA, mineralocorticoid receptor antagonist ; SGLT2-I, sodium-glucose cotransporter 2 inhibitors ; NYHA, New York Heart Association ; BNP, B-type natriuretic peptide ; LVEF, left ventricular ejection fraction ; BMI, body mass index ; e-GFR, estimated glomerular filtration rate ; CFS, clinical frailty scale.

ening frailty included not being prescribed ACE-I/ARB at discharge and no DM. In heart failure with reduced ejection fraction (HFrEF), ACE-I/ARBs are recommended to improve prognosis[19]. In heart failure with preserved ejection fraction (HFpEF), Oh[4] and Sunaga[20] showed that ACE-I/ARBs were also advantageous in patients who were frail before admission and in older male HF patients, respectively. The results of this study also support the favorable effect of ACE-I/ARB on prognosis, but the ACE-I/

ARB-treated patients in this study had shorter hospital stays, higher BMI, and higher ADL than the non-ACE-I/ARB-treated patients. This difference might be one of the reasons why the subjects were not prescribed ACE-I/ARB due to their poor condition and intolerance to the drug.

The results of this study indicating that the absence of DM affects poor prognosis contradict the results of previous studies. Although there is a report that DM does not affect poor prognosis in older patients[3)21)], further investigation of the prognostic impact of DM in older HF patients presented in this study may be warranted.

C Limitations

There are several limitations to this study. First, it is uncertain whether the results are generalizable because it was a single-center study in a hospital without cardiac surgery facilities, and the small sample size did not allow for analysis considering confounding factors. Second, changes in frailty were assessed at two time points, so that detailed changes that occurred during the 6 months after discharge from the hospital were not taken into account. Third, CFS is a semi-quantitative scale of frailty. Although medical professionals have assessed the CFS, its reproducibility has not been evaluated.

D Clinical Implications

Despite the aforementioned limitations, this study found that some older HF patients experienced worsening of frailty or died six months after hospital discharge. Moreover, the reasons for frailty deterioration included worsening of HF, other cardiovascular diseases, comorbidities, fall fractures, and dementia. These findings suggest the need for individualized efforts to prevent fall fractures, dementia, worsening of HF, other cardiovascular diseases, and comorbidities among patients. Meanwhile, the causes of frailty deterioration may be partially preventable or palliative, but this has not been examined and requires further research.

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Disclosure statement

The authors declare no conflict of interest.

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