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Prognostic utility of multipoint nutritional screening for hospitalized patients with acute decompensated heart failure

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ABSTRACT

This study aimed to evaluate the impact of serial changes in nutritional status on 1-year events including all-cause mortality or rehospitalization owing to heart failure (HF) among hospitalized patients with acute decompensated HF (ADHF). The study subjects comprised 253 hospitalized patients with ADHF. The controlling nutritional status (CONUT) score was assessed both at hospital admission and discharge. The subjects were divided into three groups according to nutritional status using CONUT score: normal (0 and 1), mild risk (2–4), and moderate to severe risk defined as malnutrition (5–12). We observed nutritional status was improved or not. The incidence of malnutrition was 30.4% at hospital admission and 23.7% at discharge, respectively. Malnutrition was independently associated with 1-year events among hospitalized patients with ADHF. Presence or absence of improvement in nutritional status was significantly associated with 1-year events ($P < 0.05$), that was independent of percentage change in plasma volume in multivariate Cox regression analyses. We determined a reference model, including gender and estimated glomerular filtration rate, using multivariate logistic regression analysis ($P < 0.05$). Adding the absence of improvement in nutritional status during hospitalization to the reference model significantly improved both NRI and IDI (0.563, $P < 0.001$ and 0.039, $P = 0.001$). Furthermore, malnutrition at hospital discharge significantly improved NRI (0.256, $P = 0.036$) In conclusion, serial changes in the nutritional status evaluated on the basis of multiple measurements may provide more useful information to predict 1-year events than single measurement at hospital admission or discharge in hospitalized patients with ADHF.

Keywords: acute heart failure, multipoint, nutritional assessment, CONUT score

Abbreviations:
HF: heart failure
ADHF: acute decompensated heart failure
CONUT: controlling nutritional status

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INTRODUCTION

The prevalence of heart failure (HF) has been increasing with the aging society in Japan.[1-4] Patients with HF who needed hospitalization have high mortality and poor prognosis even with the advancement of medical therapy.[5,6,7]

Most patients with HF have both hypercatabolic and absorption disorder statuses owing to inflammation, intestinal edema, and low output.[8] Consequently, malnutrition is commonly observed in patients with HF.[9] Moreover, malnutrition causes fluid retention and deterioration of general condition, resulting in further deterioration of nutritional condition.[8] Therefore, malnutrition is a major obstacle in treatment and rehabilitation and is a major prognostic factor of HF.[10]

Determining the controlling nutritional status (CONUT) score is known as a method for comprehensively evaluating the nutritional status, including serum albumin level, total cholesterol level, and total lymphocyte count.[11] In patients with acute HF (AHF), the usefulness of evaluating the nutritional status on the basis of the CONUT score has been reported previously.[12-15]

However, evaluation of the nutritional status of patients with HF can be affected by hemodilution. Therefore, assessing the appropriate measurement timing of the nutritional status is considered an important issue.

Therefore, this study aimed to evaluate the impact of serial changes in nutritional status on 1-year events (all-cause mortality or rehospitalization due to HF) in hospitalized patients with acute decompensated HF (ADHF).

MATERIALS AND METHODS

Study subjects

We conducted a retrospective study of 253 consecutive patients who were hospitalized for ADHF at Kasugai Municipal Hospital, Aichi, Japan between January 2010 and August 2015. In patients with multiple admissions, the first eligible hospitalization for ADHF was evaluated. We excluded the patients with ADHF owing to acute coronary syndrome, and the patients with limited life expectancy due to malignant neoplasm. Moreover, we also excluded the patients who had a history of severe liver disease defined as child-Pugh C.

All the patients were followed up for 1 year, and the association between 1-year events and change in nutritional status among patients with ADHF was examined retrospectively. 1-year events were defined as all-cause mortality or rehospitalization owing to HF after discharge.

The study protocol was in accordance with the principles of the Declaration of Helsinki and was approved by the ethics committees of human research of Kasugai Municipal Hospital. Written informed consent was obtained from each patient.

Body mass index (BMI) was calculated using the following formula: BMI = mass (kg) / height^2 (m^2). We defined anemia as serum hemoglobin level <13 mg/dL in men and <12 mg/dL in women.[16] The Strauss-Davis-Rosenbaum formula was used to estimate percentage change in plasma volume.[17,18] The formula was as follows: percentage change in plasma volume = ([(hemoglobin at hospital admission / hemoglobin at hospital discharge) × ((100-Hematocrit at hospital discharge) / (100-Hematocrit at hospital admission))]-1) × 100.

The CONUT score was using by serum albumin level, total cholesterol level, and total lymphocyte count.[11] The formula was as follows: The CONUT score = albumin score (≥3.5 g/dL [0 point], 3.0–3.4 g/dL [2 points], 2.5–2.9 g/dL [4 points], <2.5 g/dL [6 points]) + total lymphocyte score [≥1600/mL [0 point], 1200–1599/mL [1 point], 800–1199/mL [2 points], <800/mL [3 points]) + total cholesterol score [≥180 mg/dL [0 point], 140–179 mg/dL [1 point],

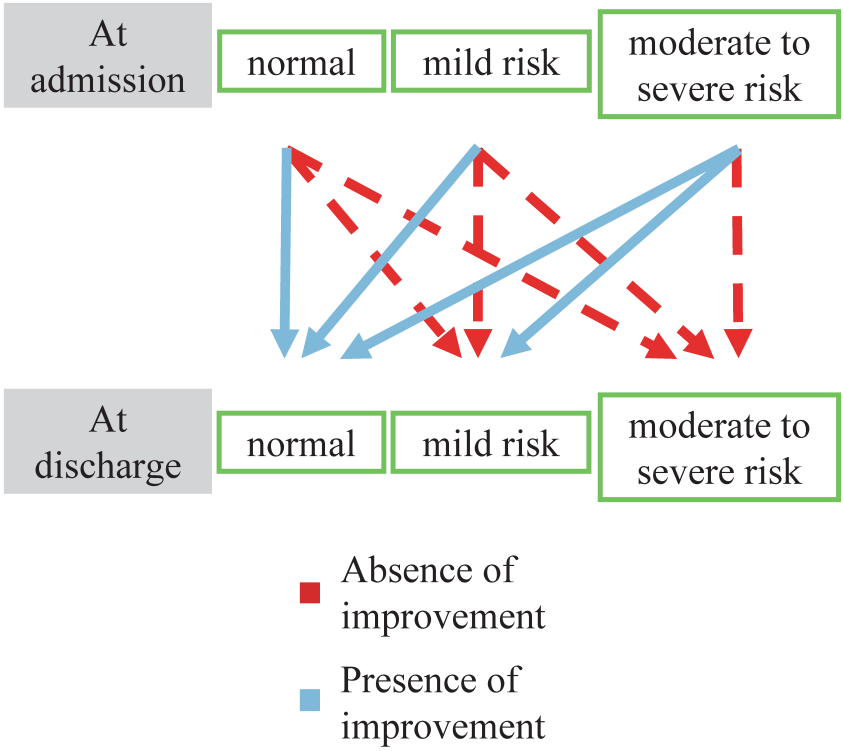

Fig. 1 Definition of change in nutritional status
The CONUT scores were assessed at both hospital admission and discharge. The study subjects were divided into three groups according to the CONUT score as follows: normal (0 and 1), mild risk (2–4), and moderate to severe risk defined as malnutrition (5–12). We observed the presence or absence of improvement in nutritional status. CONUT, controlling nutritional status.

100–139 mg/dL [2 points], <100 mg/dL [3 points]).

The CONUT score was assessed at both hospital admission and discharge. The definition of change in nutritional status is shown in Figure 1. The study subjects were divided into three groups according to the CONUT score as follows: normal (0 and 1), mild risk (2–4), and moderate to severe risk defined as malnutrition (5–12). We observed the presence or absence of improvement in nutritional status.

Statistical analyses

The distribution of the continuous variables was examined using the Shapiro-Wilk test. Continuous variables were expressed as median with the interquartile range, and categorical variables were expressed as number (percentage). Univariate and multivariate Cox regression analyses were performed to determine the predictors of 1-year events. All baseline variables with P value of <0.05 in the univariate Cox regression analysis were entered in the multivariate Cox regression analysis.

Next, we defined the baseline model that, included factors significantly and independently associated with 1-year events in the multivariate logistic regression analysis.

Finally, we calculated the C-index, net reclassification improvement (NRI), and integrated

discrimination improvement (IDI). Differences were considered statistically significant at $P < 0.05$.

Statistical analysis was performed using IBM SPSS Statistics 18.0 (IBM, Somers, NY, USA), the R version 3.2.1 software (the R Project for Statistical Computing), and the JMP version 5.1 software (SAS Institute, Cary, NC).

RESULTS

The baseline characteristics of the study subjects are shown in Table 1. The subjects' mean age was 78 (interquartile range, 70–86) years, and 53.8% of the patients were male. The etiology of HF was ischemic heart disease in 35.2% of patients. New York Heart Association classification III and IV was found in 26.4% and 70% of the cases, respectively. The hemodynamic assessment revealed a wet-warm profile of 89.7%. Left ventricular ejection fraction was 51.0% (interquartile range, 39.0%–63.0%). The nutritional statuses at hospital discharge are shown in Figure 2. The incidence of malnutrition, defined as a CONUT score 5–12, was 30.4% at hospital admission and 23.7% at discharge.

Table 1 Characteristics of study subjects

Parameter	All	Presence of improvement in nutritional status	Absence of improvement in nutritional status	*P*
Number of subjects	253	122	131	
Age (years)	78.0 (70.0–86.0)	79.0 (68.6–86.0)	78.0 (71.0–85.0)	0.543
Male gender (%)	136 (53.8)	65 (53.8)	71 (54.2)	0.883
BMI (kg/m^2)	22.4 (20.2–25.4)	22.4 (20.3–24.6)	22.7 (20.0–25.6)	0.698
Current or former smoking (%)	112 (44.3)	49 (40.2)	63 (48.1)	0.204
SBP (mmHg)	162 (133–189)	168 (133–198)	153 (131–184)	0.081
DBP (mmHg)	92 (75–109)	96 (77–109)	87 (72–108)	0.127
HR (beat per minute)	103 (88–125)	106 (88–127)	101 (86–120)	0.237
Etiology (%)				
Ischemic heart disease	89 (35.2)	43 (35.3)	46 (35.1)	0.983
Valvular heart disease	27 (10.7)	11 (9.0)	16 (12.2)	0.409
Cardiomyopathy	24 (9.5)	10 (8.2)	14 (10.7)	0.498
Hypertension	55 (21.7)	25 (20.5)	30 (22.9)	0.642
Arrhythmia	32 (12.7)	17 (13.9)	15 (11.5)	0.553
Others or undefined	26 (10.2)	16 (13.1)	10 (7.6)	0.150
Comorbidities, n (%)				
Hypertension	179 (70.8)	88 (72.1)	91 (69.5)	0.641
Diabetes Mellitus	102 (40.3)	51 (41.8)	51 (38.9)	0.642
Stroke or TIA	43 (17.0)	15 (12.3)	28 (21.4)	0.053
Atrial fibrillation or atrial flutter	63 (24.9)	35 (28.7)	28 (21.4)	0.179
COPD or Asthma	9 (3.6)	3 (2.5)	6 (4.6)	0.358
Previous MI	52 (20.6)	24 (19.7)	28 (21.4)	0.738
Dyslipidemia	62 (24.5)	32 (26.2)	30 (22.9)	0.539
Pacemaker implantation	10 (4.0)	5 (4.1)	5 (3.8)	0.909

Arrival by ambulance, n (%)	137 (9.0)	72 (59.0)	65 (49.6)	0.134
Initial evaluation				
NHYA classification at admission, n (%)				
II	9 (3.6)	6 (4.9)	3 (2.3)	0.256
III	67 (26.4)	29 (23.8)	38 (29.0)	0.345
IV	177 (70.0)	87 (71.3)	90 (68.7)	0.651
NHYA classification at discharge, n (%)				
I	176 (69.6)	84 (68.9)	92 (70.2)	0.812
II	69 (27.3)	33 (27.1)	36 (27.5)	0.939
III	8 (3.1)	5 (4)	3 (2.3)	0.410
JVD, n (%)	115 (45.5)	59 (48.4)	56 (42.8)	0.370
Hemodynamic assessment, n (%)				
Wet-warm	227 (89.7)	110 (90.2)	117 (89.3)	0.824
Wet-cold	14 (5.5)	6 (4.9)	8 (6.1)	0.679
Dry-warm	11 (4.4)	6 (4.9)	5 (3.8)	0.668
Dry-cold	1 (0.4)	0 (0)	1 (0.8)	0.251
Serum total cholesterol (mg/dL)	161 (134–184)	169 (147–194)	149 (125–172)	**<0.001**
Serum triglycerides (mg/dL)	75 (56–104)	82 (60–112)	71 (50–91)	**0.013**
Serum HDL–cholesterol (mg/dL)	41 (33–51)	42 (33–52)	41 (34–49)	0.654
Serum LDL–cholesterol (mg/dL)	96 (73–119)	103 (83–128)	92 (66–113)	**<0.001**
Fasting plasma glucose (mg/dL)	139 (109–189)	135 (103–188)	140 (113–191)	0.304
Blood hemoglobin A_{1c} (NGSP, %)	5.9 (5.5–6.8)	5.9 (5.6–6.8)	5.9 (5.4–6.7)	0.352
BUN (mg/dL)	24.5 (16.5–34.8)	24.5 (17.9–37.3)	24.7 (15.9–33.7)	0.604
Serum Sodium (mEq/L)	141 (139–143)	141 (139–143)	141 (139–143)	0.851
Serum potassium (mEq/L)	4.2 (3.9–4.6)	4.3 (3.9–4.7)	4.2 (3.8–4.6)	0.241
Serum creatinine (mg/dL)	1.12 (0.80–1.71)	1.04 (0.8–1.85)	1.16 (0.81–1.63)	0.499
eGFR (ml min^{-1} 1.73 m^{-2})	45.1 (24.5–60.9)	45.9 (20.9–62.8)	43.1 (27.0–59.3)	0.896
Serum uric acid (mg/dL)	7.5 (5.5–8.8)	7.0 (5.1–8.5)	7.7 (5.7–9.0)	0.077
Serum albumin (mg/dL)	3.6 (3.2–3.9)	3.7 (3.4–3.9)	3.4 (3.1–3.8)	**<0.001**
Serum CRP (mg/L)	0.8 (0.2–2.2)	0.7 (0.2–1.8)	1.0 (0.4–3.0)	**0.007**
BNP at admission (pg/mL)	756 (438–1517)	698 (368–1515)	854 (451–1540)	0.372
BNP at discharge (pg/mL)	243 (128–488)	254 (124–542)	236 (129–463)	0.897
White blood cells (10^3/μl)	8.1 (6.1–10.5)	8.8 (6.0–10.55)	7.8 (6.1–10.5)	0.615
Total lymphocytes (/μl)	1452 (911–2011)	1653 (1194–2494)	1168 (760–1805)	**<0.001**
Hemoglobin (mg/dL)	11.6 (10.1–13.7)	11.6 (10.3–13.9)	11.4 (9.9–13.5)	0.200
Anemia, n (%)	155 (61.3)	71 (58.2)	84 (64.1)	0.334
LVEF at admission (%)	51.0 (39.0–63.0)	53.0 (40.3–64.8)	50.0 (38.0–62.0)	0.271
LVEF at discharge (%)	52.0 (43.0–64.0)	51.0 (42.0–63.0)	55.0 (43.0–65.0)	0.304
Statin (%)	59 (23.3)	26 (21.3)	33 (25.2)	0.465
Change in PVol (%)	1.82 (–9.35–14.2)	–3.43 (–13.5–7.53)	5.73 (–5.91–21.3)	**<0.001**
CONUT score at admission, n (%)				
normal	69 (27.3)	18 (14.7)	51 (38.9)	**<0.001**
mild risk	107 (42.3)	55 (45.1)	52 (39.7)	0.386

moderate to severe risk	77 (30.4)	49 (40.2)	28 (21.4)	**0.001**
CONUT score at discharge, n (%)				
normal	78 (30.8)	54 (44.3)	24 (18.3)	**<0.001**
mild risk	115 (45.5)	60 (49.2)	55 (42.0)	0.251
moderate to severe risk	60 (23.7)	8 (6.5)	52 (39.7)	**<0.001**

Categorical variables are described as percentages and variables using median and 25th-75th percentile range.
BMI: Body Mass Index
SBP: Systolic Blood pressure
DBP: Diastolic Blood pressure
HR: Heart rate
TIA: Transient ischemic attack
COPD: Chronic obstructive pulmonary disease
MI: Myocardial infarction
NHYA: New York Heart Association
JVD: Juglar venous distension
HDL: high density lipoprotein
LDL: low density lipoprotein
BUN: Blood urea nitrogen
eGFR: estimated glomerular filtration rate
CRP: C-reactive protein
BNP: brain natriuretic peptide
LVEF: left ventricular ejection fraction
PVol: plasma volume
CONUT: controlling nutritional status.
P<0.05 was considered statistically significant and shown in bold.

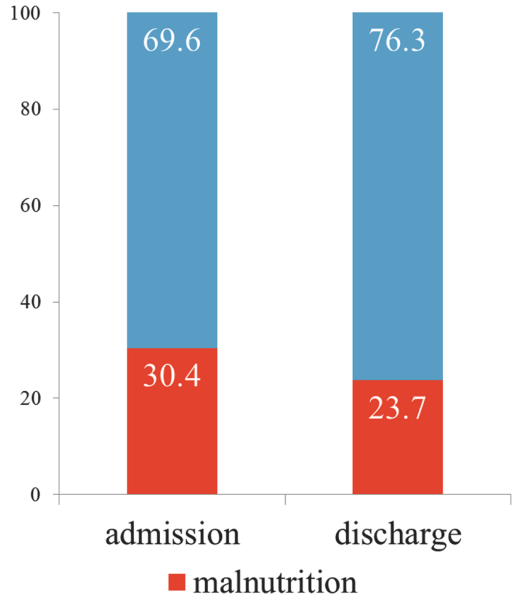

Fig. 2 Nutritional status at hospital admission and discharge
The red bar indicates the patients with malnutrition; the blue bar, the patients without malnutrition.
Malnutrition was observed in 30.4% and 23.7% of the patients at hospital admission and discharge, respectively.

In hospital treatments and 1-year events are shown in Table 2. Improvement in the nutritional status from hospital admission to discharge was observed in only in 48.2% of the enrolled patients (Figure 3). The 1-year events occurred in 26.5% (all-cause mortality,10.3% and rehospitalization owing to HF, 20.6%). The length of hospital stay was 18 (interquartile range, 12–25) days. Diuretics was used in 87.4% of the patients. Absence of improvement in nutritional status was significantly greater in patients with events than in those without events (P<0.05) (Figure 4).

Table 2 In-hospital treatments and 1-year events

Parameter	All	Presence of improvement in nutritional status	Absence of improvement in nutritional status	*P*
In-hospital treatments				
Intravenous drug therapy, n (%)				
Diuretics	221 (87.4)	107 (87.7)	114 (87.0)	0.870
Nitrates	166 (65.6)	65 (53.3)	101 (77.1)	**<0.001**
Carperitide	34 (13.4)	20 (16.4)	14 (10.7)	0.183
Inotropes	106 (41.9)	49 (40.2)	57 (43.5)	0.590
NPPV, (%)	17 (6.7)	6 (4.9)	11 (8.4)	0.265
Intubation, (%)	16 (6.3)	5 (4.1)	11 (8.4)	0.155
1-year events				
All cause mortality, n (%)	26 (10.3)	5 (4.1)	21 (16.0)	**0.001**
Rehospitalization due to heart failure, n (%)	52 (20.6)	19 (15.6)	33 (25.2)	0.057
Hospital length of stay (days)	18 (12–25)	17 (12–25)	18 (12–26)	0.899

Categorical variables are described as percentages and variables using median and 25th-75th percentile range.
NPPV: Non-invasive positive pressure ventilation.

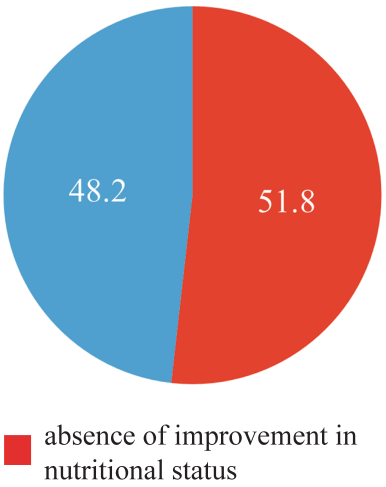

Fig. 3 Rates of presence or absence of improvement in nutritional status
The red portion indicates the patients without improvement in nutritional status, and the blue portion indicates the patients with improvement in nutritional status.
Absence and presence of improvement in nutritional status were observed in 51.8% and 48.2% of the patients, respectively.

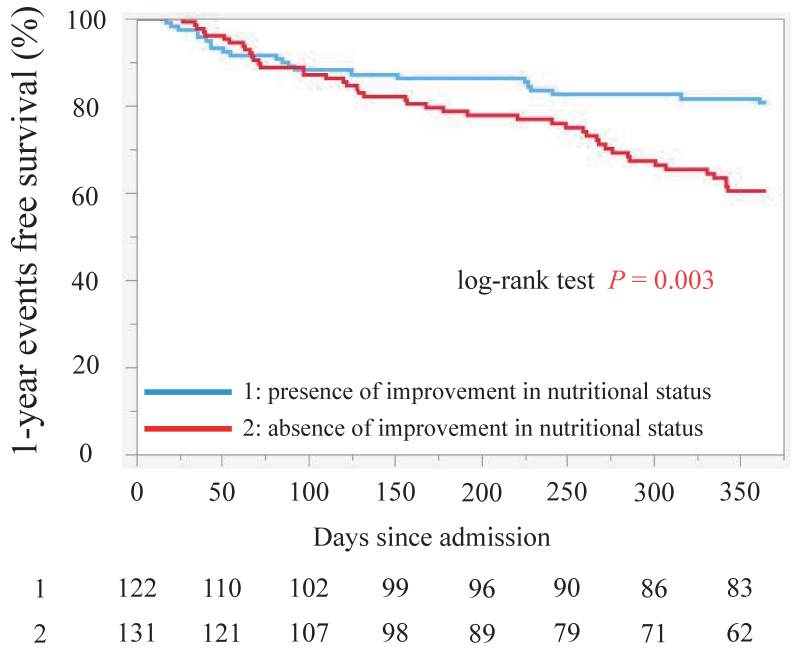

Fig. 4 Kaplan-Meier curves for 1-year events

Kaplan-Meier curves for 1-year events in patients with presence or absence improvement in nutritional status (The red line; absence of improvement in nutritional status; The blue line; presence of improvement in nutritional status).

Malnutrition at hospital discharge and absence of nutritional improvement during hospitalization were significantly related to the occurrence of 1-year events in the univariate Cox regression analysis (hazard ratio [HR] 1.36, 95% confidence interval [CI] 1.05–1.75, P = 0.021 and HR 1.62, 95% CI 1.24–2.16, P < 0.001, respectively).

Result of the univariate and multivariate Cox regression analyses of the association with 1-year events are shown in Table 3. Gender, estimated glomerular filtration rate (eGFR), and absence of improvement in nutritional status were significantly associated with 1-year events in this study, that was independent of percentage change in plasma volume (gender: HR 0.29, 95% CI 0.12–0.70, P = 0.005; eGFR: HR 0.98, 95% CI 0.96–0.99, P = 0.007; absence of improvement in nutritional status: HR 2.04, 95% CI 1.05–3.97, P = 0.036).

Table 3 Univariate and multivariate cox regression analysis associated with 1-year events

Parameter	Univariate analysis		Multivariate analysis	
	P	HR (95% CI)	*P*	HR (95% CI)
Age (years)	**0.003**	1.03 (1.01–1.06)	0.346	
Male gender	**0.001**	0.67 (0.52–0.85)	**0.005**	0.29 (0.12–0.70)
BMI (kg/m^2)	0.733	0.99 (0.93–1.05)		
Current or former smoker	**0.049**	0.78 (0.60–1.00)	0.190	
SBP (mmHg)	**0.036**	0.99 (0.99–1.00)	0.615	
DBP (mmHg)	**0.008**	0.99 (0.98–1.00)		
HR (beat per minute)	0.064	0.99 (0.98–1.00)		

Serum total cholesterol (mg/dL)	0.326	1.00 (0.99–1.00)		
Serum triglycerides (mg/dL)	0.504	1.00 (1.00–1.01		
Serum HDL–cholesterol (mg/dL)	0.715	1.00 (0.97–1.02)		
Serum LDL–cholesterol (mg/dL)	0.515	1.00 (0.99–1.00)		
Fasting plasma glucose (mg/dL)	0.856	1.00 (1.00–1.00)		
Blood hemoglobin A_{1c} (NGSP, %)	0.247	0.85 (0.63–1.11)		
BUN (mg/dL)	**<0.001**	1.03 (1.01–1.04)		
Serum Sodium (mEq/L)	0.476	0.98 (0.93–1.04)		
Serum potassium (mEq/L)	0.070	1.38 (0.97–1.90)		
Serum creatinine (mg/dL)	**<0.001**	1.26 (1.11–1.39)		
eGFR (ml min^{-1} 1.73 m^{-2})	**0.001**	0.98 (0.96–0.99)	**0.007**	0.98 (0.96–0.99)
Serum uric acid (mg/dL)	0.203	1.07 (0.96–1.19)		
Serum albumin (mg/dL)	0.590	1.13 (0.73–1.78)		
Serum CRP (mg/L)	0.508	0.98 (0.89–1.04)		
BNP (pg/mL)	0.882	1.00 (1.00–1.00)		
White blood cells (10^3/μl)	0.621	1.00 (1.00–1.00)		
Total lymphocytes (/μl)	0.751	1.00 (1.00–1.00		
Hemoglobin (mg/dL)	**0.006**	0.86 (0.78–0.96)		
Anemia, n (%)	**0.025**	1.34 (1.04–1.77)	0.692	
LVEF (%)	0.911	1.00 (0.98–1.02)		
Change in PVol (%)	0.52	0.99 (0.98–1.01)	0.051	
Malnutrition at hospital admission	0.166	0.83 (0.61–1.08)		
Malnutrition at hospital discharge	0.021	1.36 (1.05–1.75)		
absence of improvement in nutritional status	**<0.001**	1.62 (1.24–2.16)	**0.036**	2.04 (1.05–3.97)

HR: hazard ratio
95% CI: 95% confidence interval
BMI: Body Mass Index
SBP: Systolic Blood pressure
DBP: Diastolic Blood pressure
HR: Heart rate
HDL: high density lipoprotein
LDL: low density lipoprotein
eGFR: estimated glomerular filtration rate
BNP: brain natriuretic peptide
BUN: Blood urea nitrogen
eGFR: estimated glomerular filtration rate
CRP: C-reactive protein
BNP: brain natriuretic peptide
LVEF: left ventricular ejection fraction
PVol: plasma volume.
P<0.05 was considered statistically significant and shown in bold.

After that, we determined a baseline model including gender and eGFR by using logistic regression analysis. Adding absence of improvement in the nutritional status during hospitalization to the baseline model significantly improved both the NRI and IDI (NRI 0.563, $P < 0.001$; IDI 0.039, $P = 0.001$). Similarly, adding malnutrition at hospital discharge significantly improved the NRI (0.256, P = 0.036) (Table 4).

Table 4 Discrimination of each predictive for 1-year events using the C-index, NRI and IDI

Parameter	C-index (95% CI)	*P*	NRI	*P*	IDI	*P*
Baseline model	0.705 (0.306–0.779)	Ref.		Ref.		Ref.
Baseline + malnutrition at hospital admission	0.714 (0.640–0.787)	0.395	0.178	0.105	0.009	0.105
Baseline + malnutrition at hospital discharge	0.716 (0.645–0.787)	0.393	0.256	**0.036**	0.009	0.120
Baseline + absence of improvement in nutritional status	0.739 (0.671–0.806)	0.549	0.563	**<0.001**	0.039	**0.001**

Baseline model included male gender and estimated glomerular filtration rate.
95% CI: 95% confidence interval
NRI: net reclassification improvement
IDI. $P<0.05$ was considered statistically significant and shown in bold.

DISCUSSION

The main finding of the study was that adding serial changes in nutritional status and malnutrition at hospital discharge improved the prediction ability of 1-year events in hospitalized patients with ADHF. In addition, we evaluated the CONUT score by the change of category.

Several reports have claimed that malnutrition is commonly observed in patient with HF and is an independent prognostic factor of HF.[19-21] In this study, malnutrition was observed in 30.4% of the enrolled subjects, in line with a previous report.[13]

Moreover, previous reports identified that serum albumin level,[22] total cholesterol level,[23] and total lymphocyte count[24] were independent prognostic factors of HF. Serum albumin level, total cholesterol level, and total lymphocyte count are considered to reflect protein metabolizing, lipid metabolizing, and immunological abilities, respectively. Thus, the CONUT score, which is calculated from serum albumin level, total cholesterol level, and total lymphocyte count, enables a comprehensive nutritional evaluation and prediction of worse clinical events. In this study, hypoalbuminemia, lower cholesterol levels and lower lymphocyte counts based on the CONUT score was higher in the absence of improvement in nutritional status group, although the absolute values of each score were higher in the presence of improvement in nutritional status group. That might be due to the score ratio of each components of the CONUT score. Therefore, we presumed that the CONUT score could predict prognosis in HF.

However, application of the CONUT score in patients with HF has several problems. Albumin levels are affected by hemodilution, inflammation, and exhaustion owing to invasion of AHF.[25] Total cholesterol levels are affected by dyslipidemia and statin use. Total lymphocyte counts are affected by inflammation, stress response, or steroid use.[26] We thought that the influence of body weight (fluid depletion) on nutritional assessment is not small. In addition, a body weight is often included in a factor for other nutritional assessments. Therefore, we aimed to investigate serial changes in the CONUT score, in which a weight factor is not included, to evaluate the precise impact of the nutritional status on 1-year events in patients with ADHF.

A previous study reported that the assessment of serial serum albumin levels in patients with AHF correlated with prognosis in AHF.[27] Moreover, previous reports showed that the longitudinal nutritional assessments of geriatric nutritional risk index and malnutrition-inflammation score are useful to predict the prognosis of patients receiving dialysis.[28] The present study also showed that the evaluation of serial changes in the nutritional status during hospitalization might further aid in predicting mortality in patients with HF.

Several reports have recommended the implementation of a multidisciplinary disease management program by a multidisciplinary HF team, which has been shown to improve clinical outcomes in patients with HF.[29-33] Treatment of HF after hospitalization leads to improvement of intestinal ischemia affected by low output syndrome, increased peristalsis or improved absorption disorders. Moreover, it improves intestinal edema due to gastrointestinal congestion, that improves abdominal fullness and loss of appetite.[8] Therefore, we considered that risk stratification based on the multipoint nutritional screening of patients with ADHF can lead to improve the prognosis of patients with ADHF.

We have also started multidisciplinary medical interventions, such as nutrition supports by a special team, immediately after hospitalization to prevent progression of frail. We thought that both multidisciplinary medical interventions and treatment of heart failure were resulted in improvement of nutritional status during hospitalization.

Our study has several limitations. First, this study was conducted at a single center and included a small number of patients. Second, nutritional screening might differ depending on the etiology of HF. Third, the CONUT score might be inadequate for assessing malnutrition in patients with inflammatory diseases or those treated with lipid-lowering drugs such as statins. Fourth, the CONUT score can be affected by hemodilution, although we could not directly evaluate the degree of hemodilution. Fifth, we could not accurately exclude the concomitant liver disease. Sixth, we could not evaluate some important variables such as proteinuria. Final, we could not evaluate whether nutritional intervention affected the change in the nutritional status.

Therefore, further studies with large sample sizes are needed to examine our findings in the future.

CONCLUSIONS

In conclusion, serial changes in nutritional status evaluated on the basis of multiple measurements may provide more useful information to predict 1-year events than single measurement at hospital admission or discharge in hospitalized patients with ADHF in Japan.

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CONFLICT OF INTEREST STATEMENT

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The other authors declare that there is no conflict of interest.

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