Six-Minute Walk Distance Is an Independent Predictor of Hospital Readmission in Patients With Chronic Heart Failure

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SUMMARY

Patients with chronic heart failure (CHF) are frequently readmitted to the hospital due to disease progression. Although a shorter 6-minute walk distance (6MWD) is correlated with poor prognosis, 6MWD is not considered a clinical indicator for predicting hospital readmission.

We investigated whether 6MWD measured at the time of hospital discharge predicted readmission due to heart failure in CHF patients.

Patients admitted to the hospital for the first time due to heart failure were enrolled. After 6MWD was measured at discharge, patients were followed-up for 3 years. Clinical characteristics, 6MWD and readmission due to heart failure were evaluated in 252 patients (68.5 ± 11.8 years old, 162 males). Significant factors that affected readmission were extracted and cut-off values were determined using multivariate logistic regression analysis and receiver operating characteristic curves.

Of 252 CHF patients, 103 were readmitted within 3 years. 6MWD at the time of discharge was significantly shorter in readmitted patients than non-readmitted patients ($P < 0.001$) and was a significant predictor of readmission ($P < 0.001$). The odds ratio for readmission was 1.22 ($P < 0.001$) with each 10-meter decrease in 6MWD. The 6MWD cut-off value was determined to be 390 meters, with a sensitivity of 0.75 and a specificity of 0.77.

6MWD measured at the time of discharge is an independent predictor of hospital readmission in CHF patients, with a cut-off value of 390 meters. (Int Heart J 2014; 55: 331-336)

Key words: Exercise capacity, Cardiac rehabilitation

Table I. Patient Characteristics

	Total	Male	Female	P
Number of patients	252	162	90	
Age (years)	68.5 ± 11.3	67.5 ± 10.9	70.4 ± 11.9	NS
Height (m)	1.59 ± 0.11	1.64 ± 0.09	1.53 ± 0.06	P < 0.005
BNP (pg/mL)	998 ± 831	1021 ± 809	957 ± 870	NS
LVEF (%)	35.4 ± 12.8	31.9 ± 11.6	41.9 ± 13.4	P < 0.001
Primary diseases				NS
Ischemic heart disease	77 (30.6%)	57 (35.2%)	20 (22.2%)	
Valvular heart disease	50 (19.8%)	24 (14.8%)	26 (28.9%)	
Cardiomyopathy	73 (29.0%)	55 (33.9%)	18 (20.0%)	
Hypertension	29 (11.5%)	15 (9.3%)	14 (15.6%)	
Others	23 (9.1%)	11 (6.8%)	12 (13.3%)	
NYHA functional classification at admission				NS
Class III	43 (17.1%)	32 (12.7%)	11 (4.4%)	
Class IV	209 (82.9%)	130 (51.6%)	79 (31.3%)	
NYHA functional classification at discharge				
Class II	218 (86.5%)	144 (57.1%)	74 (29.4%)	NS
Class III	34 (13.5%)	18 (7.1%)	16 (6.4%)	
6MWD (m)	401.4 ± 79.2	418.3 ± 75.4	369.8 ± 76.7	P < 0.001
Duration of hospitalization (days)	18.4 ± 13.1	17.9 ± 12.2	18.7 ± 14.4	NS
No. of readmitted patients	103	64	39	NS
Cumulative readmission rate	40.9%	39.5%	43.3%	NS

Data are presented as mean ± SD. M indicates meters; LVEF, left ventricular ejection fraction; 6MWD, 6-minute walk distance; BNP, plasma brain natriuretic peptide; and NYHA, New York Heart Association.
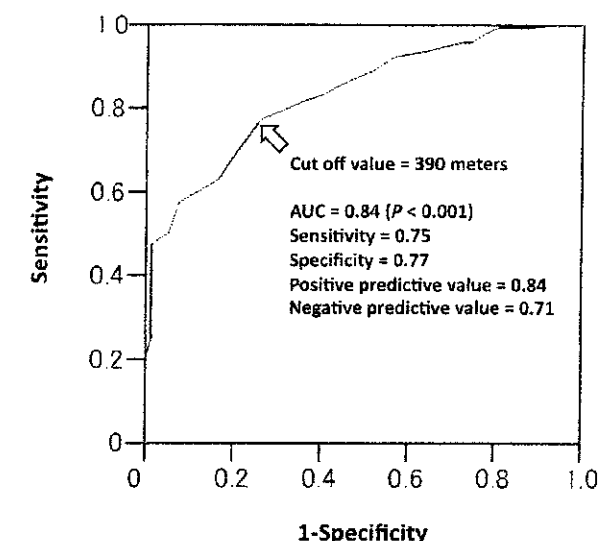
Table II. Characteristics of Readmitted and Non-Readmitted Patients

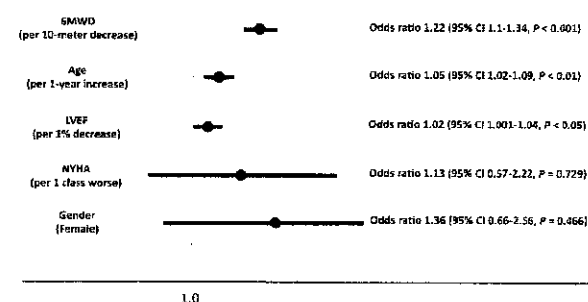|	Readmitted patients	Non-readmitted patients	P
Number of patients	103	149	
Male / Female	64 / 39	98 / 51	NS
Age (years)	70.0 ± 10.2	69.6 ± 12.0	NS
Height (m)	1.56 ± 0.12	1.62 ± 0.11	NS
BNP (pg/mL)	958 ± 655	1,009 ± 963	NS
LVEF (%)	34.4 ± 11.5	36.1 ± 13.7	NS
Primary diseases			NS
Ischemic heart disease	38 (36.9%)	39 (36.9%)	
Valvular heart disease	23 (22.3%)	27 (18.1%)	
Cardiomyopathy	26 (25.2%)	47 (31.5%)	
Hypertension	6 (5.8%)	23 (15.5%)	
Others	13 (9.7%)	13 (8.7%)	
NYHA functional classification at admission			NS
Class III	19 (7.5%)	24 (9.5%)	
Class IV	97 (38.5%)	112 (44.5%)	
NYHA functional classification at discharge			P < 0.05
Class II	83 (32.9%)	135 (53.6%)	
Class III	20 (7.9%)	14 (5.6%)	
6MWD (m)	347.7 ± 57.3	437.8 ± 70.9	P < 0.001
Duration of hospitalization (days)	19.4 ± 16.2	18.2 ± 14.4	P < 0.05

Data are presented as mean ± SD; m indicates meters; LVEF, left ventricular ejection fraction; 6MWD, 6-minute walk distance; BNP, plasma brain natriuretic peptide; and NYHA, New York Heart Association.
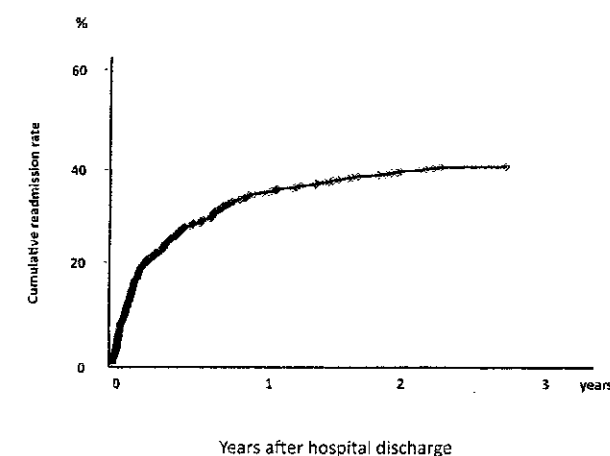
Figure 1. Cumulative readmission rate in CHF patients within 3 years of hospital discharge. CHF indicates chronic heart failure.

Figure 2. Significant predictors and odds ratios for readmission as assessed by multivariate logistic regression analysis. Multivariate logistic regression analysis extracted 6MWD at hospital discharge, age and LVEF as significant independent limiting factors of readmission due to CHF. CHF indicates chronic heart failure, 6MWD; 6-minute walk distance, LVEF, left ventricular ejection fraction, NYHA; New York Heart Association; and CI, confidence interval.

Table III. Model fit Accessed by Hosmer-Lemeshow Test

Limiting factors for readmission	χ^2	P	Predictive value
6MWD	13.49	P = 0.096	74.6%
6MWD and age	5.93	P = 0.655	75.4%
6MWD, age and LVEF	18.82	P = 0.016	77.5%

6MWD indicates 6-minute walk distance and LVEF, left ventricular ejection fraction.

Figure 3. ROC curve to predict readmission using 6MWD. The AUC for 6MWD at discharge was 0.84 in CHF patients ($P < 0.001$), with 390 meters as the optimum 6MWD cut-off value. ROC indicates receiver operating characteristic; 6MWD, 6-minute walk distance; AUC, area under the ROC curve; and CHF, chronic heart failure.

Table IV. Actual Number of Readmitted and Non-Readmitted Patients Using the 6MWD Cut-Off Value

6MWD cut-off value	Readmitted patients	Non-readmitted patients
6MWD ≤ 390 meters	80 (31.8%)	33 (13.1%)
6MWD > 390 meters	23 (9.1%)	116 (46.0%)

$\chi^2 = 66.24$ ($P < 0.001$). 6MWD indicates 6-minute walk distance.