Clinical Investigations

Prognostic Value of Estimating Functional Capacity With the Use of the Duke Activity Status Index in Stable Patients With Chronic Heart Failure

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ABSTRACT

Background: Over the years, several methods have been developed to reliably quantify functional capacity in patients with heart failure. Few studies have investigated the prognostic value of these assessment tools beyond cardiorenal prognostic biomarkers in stable patients with chronic heart failure.

Methods and Results: We administered the Duke Activity Status Index (DASI) questionnaire, a self-assessment tool comprising 12 questions for estimating functional capacity, to 1,700 stable nonacute coronary syndrome patients with history of heart failure who underwent elective diagnostic coronary angiography with 5-year follow-up of all-cause mortality. In a subset of patients (n = 800), B-type natriuretic peptide (BNP) was measured. In our study cohort, the median DASI score was 26.2 (interquartile range [IQR] 15.5−42.7). Low DASI score provided independent prediction of a 3.3-fold increase in 5-year mortality risk (quartile 1 vs quartile 4: hazard ratio [HR] 3.33, 95% confidence interval [CI] 2.57−4.36; $P < .0001$). After adjusting for traditional risk factors, BNP, and estimated glomerular filtration rate, low DASI score still conferred a 2.6-fold increase in mortality risk (HR 2.57, 95% CI 1.64−4.15; $P < .0001$).

Conclusions: A simple self-assessment tool of functional capacity provides independent and incremental prognostic value for mortality prediction in stable patients with chronic heart failure beyond cardiorenal biomarkers. (*J Cardiac Fail 2015;21:44−50*)

Key Words: Chronic heart failure, functional status, prognosis.

There are nearly 6 million adults in the United States carrying a diagnosis of heart failure (HF), with the lifetime risk estimated to be 1 in 5.[1] Although current medical and device therapies for HF have dramatically improved outcomes, mortality remains high in some subgroups.[2] Therefore, identifying poor prognostic markers early may provide opportunities for intensifying therapy. High natriuretic peptides,[3] cardiac troponin elevation,[4] and poor performance on exercise stress testing identify HF cohorts at increased risk for death over time. Functional status impairment can occur in the setting of chronically impaired cardiac output and chronic central or peripheral venous congestion.

The Duke Activity Status Index (DASI) is a simple 12-question self-assessment tool for estimating functional capacity (Table 1). DASI scores correlate well with peak oxygen uptake (Spearman rho = 0.81; $P < .0001$) and are validated (Spearman rho = 0.58; $P < .0001$) measures of functional status in patients with HF.[5] After admission for acute decompensated HF, DASI scores predict event-free survival.[6] However, the long-term prognosis of functional status measures in stable patients with HF has not been elucidated. In the present study, we determined the

Table 1. Duke Activity Status Index (DASI)

Can You:	Weight
Take care of yourself, that is, eat, dress, bathe, or use the toilet?	2.75
Walk indoors, such as around your house?	1.75
Walk a block or two on level ground?	2.75
Climb a flight of stairs or walk up a hill?	5.50
Run a short distance?	8.00
Do light work around the house like dusting or washing dishes?	2.70
Do moderate work around the house like vacuuming, sweeping floors, or carrying groceries?	3.50
Do heavy work around the house like scrubbing floors or lifting or moving heavy furniture?	8.00
Do garden work like raking leaves, weeding, or pushing a lawn mower?	4.50
Have sexual relations?	5.25
Participate in moderate recreational activities like golf, bowling, dancing, doubles tennis, or throwing a ball?	6.00
Participate in strenuous sports like swimming, singles tennis, football, basketball, or skiing?	7.50

Range: 0 (worst) to 58.2 (best).

long-term prognostic value of functional status assessment in stable patients with chronic HF.

Methods

Study Population

The Cleveland Clinic Genebank study prospectively enrolled a total of 8,987 subjects who underwent coronary angiography in the absence of an acute coronary syndrome, without a history of revascularization within 30 days before enrollment, and ≥ 5 years of long-term adjudicated follow-up data. Detailed medical histories were obtained on all subjects (predominantly outpatients) at enrollment. Blood samples were collected at the time of cardiac catheterization after arterial sheath placement, but before the catheterization procedure or any therapy (including anticoagulation medications). Every participant gave written informed consent approved by the Institutional Review Board.

Data Collected

The present analysis included 1,700 of consecutive subjects with a medical history of HF with reduced or preserved left ventricular ejection fraction (LVEF) enrolled in Genebank, who completed the DASI questionnaire (Table 1) and with corresponding blood samples for analysis. Chronic HF was defined as a documented history of HF by treating physician in the electronic medical record and confirmed by study personnel at the time of enrollment. Heart failure was defined as a documented history of HF by the treating cardiologist in the electronic medical record at the time of enrollment.

Biomarkers and Echocardiography

B-Type natriuretic peptide (BNP), creatinine, fasting lipid profiles, cardiac troponin I (TnI), uric acid, and high-sensitivity C-reactive protein (hs-CRP) were measured on the Abbot Architect platform (Abbott Laboratories, Abbot Park, Illinois). An estimate of glomerular filtration rate (eGFR) was calculated with the use of the Modification of Diet in Renal Disease equation. LVEF was determined via transthoracic echocardiography by the Cleveland Clinic echocardiography laboratory reviewed by Board-certified cardiologists with the use of chart review of the electronic medical record.

Adjudicated outcomes were prospectively ascertained over the ensuing 5 years for all subjects after enrollment.

DASI Questionnaire

Patients were asked to complete the DASI survey, supervised by study personnel, at the time of coronary angiography. The DASI is a self-administered questionnaire that measures both functional capacity and quality of life aspects. It correlates well with peak oxygen uptake on stress testing.[5] The survey attempts to capture major aspects of physical function: personal hygiene, ambulation, routine tasks, recreation, and sexual function. High scores correlate with better functional capacity. This questionnaire has been validated in similar populations.[7,8]

Statistical Analysis

This cohort was split into quartiles of DASI score for the population. P values of $\leq .05$ were considered to be significant to reject the null hypothesis that there were no differences in mortality at 5 years of follow-up between the highest and lowest DASI score quartiles. Independent variable was DASI score quartile, and dependent variable was mortality at 5 years. Parametric and nonparametric approaches were used to express continuous variables. Survival analyses were completed with the use of the Kaplan-Meier method and log-rank analysis to compare survival curves among the 4 quartiles. Cox proportional hazards models were used to compare time-to-event analyses to determine hazard ratios (HRs) and 95% confidence intervals (CIs) for 5-year mortality between the 1st and 4th quartiles of DASI scores. Multivariate models were adjusted for traditional cardiac risk factors, including age, sex, systolic blood pressure, cigarette smoking, history of diabetes, and fasting low-density lipoprotein and high-density lipoprotein cholesterol levels. Additional adjustments were made for a subset with both measured BNP and eGFR values. Subgroups were divided according to age ≥ 60 years, LVEF $<45\%$, eGFR <60 mL min^{-1} 1.73 m^{-2}, history of coronary artery disease (CAD), TnI ≥ 0.03 ng/mL, sex, uric acid ≥ 9.8 mg/dL, hs-CRP ≥ 2 mg/dL, history of diabetes mellitus, and history of chronic obstructive pulmonary disease (COPD). Statistical analyses were performed with the use of JMP Pro version 9 (SAS Institute, Cary, North Carolina).

Results

Baseline characteristics are described in Table 2 and are representative of a patient population with chronic HF. The reasons for cardiac catheterization within the study cohort were as follows (subjects can have >1 reason): history of positive or abnormal stress test (30%), evaluation for possible ischemic causes of symptoms (63.5%), preoperative evaluation (24%), and history of cardiomyopathy (14%). DASI surveys were successfully completed by 1,700 study participants, and scores across this study cohort were nonparametrically distributed (Fig. 1). The median DASI score was 26.2 (interquartile range 15.5−42.7). The mean DASI scores for quartiles 1−4 were 8.7 ± 3.7, 20.2 ± 3.2, 33.4 ± 3.9, and 50.0 ± 5.9, respectively. Decreasing DASI scores were associated with increasing comorbidity (Table 2), but not with LVEF ($P = .4$). There were no differences in either angiotensin-converting