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ORIGINAL ARTICLE

Left ventricular geometry, risk factors, and outcomes of hospitalized patients with diastolic heart failure in Japan

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Summary
Background: Studies of the characteristics, risk factors, prognostic factors, and outcomes of diastolic heart failure (DHF) have yielded inconsistent findings. Moreover, few epidemiological studies of DHF have been performed in Japan.
Methods and results: We studied patients with heart failure who were admitted consecutively to Yokohama City University Hospital from 2000 through 2003. Heart failure with a left ventricular ejection fraction (LVEF) of $\geq$50% was classified as DHF ($n = 67$), and that with an LVEF of $\leq$35% was classified as systolic heart failure (SHF; $n = 72$). Relative wall thickness (RWT) (0.61 vs. 0.34, $p < 0.0001$) and left ventricular mass index (210.3 vs. 152.1, $p < 0.0001$) were greater in DHF than in SHF. Age (odds ratio [OR] = 1.068, 95% CI = 1.020—1.119; $p = 0.006$) and RWT (OR = 17.945, CI = 5.883—54.745; $p < 0.0001$) were positive risk factors for DHF. A history of myocardial infarction was a negative risk factor for DHF (OR = 0.053, CI = 0.008—0.342; $p = 0.002$). Left ventricular mass index was slightly but not significantly related to DHF (OR = 1.010, CI = 1.000—1.019; $p = 0.053$). Survival did not differ significantly between patients with DHF and those with SHF. Advancing age and a greater RWT were positive risk factors for DHF.

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Conclusion: LV geometry of DHF and SHF are quite different. DHF is characterized by concentric hypertrophy of the left ventricle, whereas SHF is characterized by eccentric hypertrophy. Age and RWT were positive risk factors for DHF. Survival is similar in DHF and SHF.

Introduction

Although 40—50% of patients with heart failure have a preserved ejection fraction [1—3] and many studies have focused on diastolic heart failure (DHF), little is known about the characteristics, risk factors, and prognostic factors of DHF. Whether survival is better in DHF than in systolic heart failure (SHF) also remains unclear because previous studies have yielded inconsistent findings. Moreover, few epidemiological studies of DHF have been performed in Japan.

This study was designed to clarify the characteristics, left ventricular (LV) geometry, risk factors, prognostic factors, and outcomes of DHF as compared with those of SHF in the Japanese population.

Methods

This was a retrospective cohort study. Patients with heart failure who were consecutively admitted to Yokohama City University Hospital from April 1, 2000 through March 31, 2003 were studied. Heart failure was diagnosed according to the Framingham study criteria [4]. For patients who were admitted two or more times, only data from the initial admission were analyzed. On admission, each patient's medical history was reviewed. Echocardiographic and laboratory test data obtained on admission were used in this study. Left ventricular ejection fraction (LVEF) was measured by echocardiography. Heart failure with an LVEF of $\geq$50% was classified as DHF, and that with an LVEF of $\leq$35% was classified as SHF. Heart failure with an LVEF between 35% and 50% was classified as intermediate type. To clarify fundamental differences between DHF and SHF, patients with intermediate type heart failure were excluded from this study. Creatinine clearance was estimated according to the formula of Cockcroft and Gault as follows [5]: creatinine clearance (ml/min) = $K \times (140 - \text{age})$ body weight (kg)/(72 × serum creatinine concentration), with K equal to 1 for men and ×0.85 for women. Left ventricular mass index (LVMI) and relative wall thickness (RWT) were calculated using the following equations, as recommended by the European Association of Echocardiography and the American Society of Echocardiography [6,7]:LVMI (g/m^2) = $(0.8 \times \{1.04 \times [(\text{LVDd} + \text{IVSTd} + \text{PWTd})^3 - (\text{LVDd})^3]\} + 0.6)$/body surface area, RWT = $(2 \times \text{PWTd})/\text{LVDd}$, where LVDd indicates left ventricular diameter in diastole, IVSTd indicates interventricular septal wall thickness in diastole, and PWTd indicates left ventricular posterior wall thickness in diastole. RWT permits categorization of an increase in LV mass as either concentric (RWT >0.42) or eccentric (RWT $\leq$0.42), and of normal LV mass as either eccentric remodeling or normal geometry [7]. Smoking history was estimated by the Brinkman index as follows: number of cigarettes smoked per day × the number of years of smoking. The alcohol intake score was calculated by the following equation: 1 unit (about 20 ml ethanol per day) × number of years of drinking. Outcomes after discharge were surveyed until May 6, 2007. The follow-up period ranged from 4 years 2 months to 7 years 2 months. Follow-up information was obtained by reviewing the medical records of our hospital. Information on patients who did not return to our outpatient clinic was obtained by telephone interviews with surviving patients, family members, or patients' personal physicians.

Statistical analysis

Numerical data are expressed as means ± SE. The statistical significance of differences between DHF and SHF was evaluated by Student's *t*-test and Chi-square test. Risk factors were evaluated by multivariate logistic regression analysis (dependent variable = 1 if DHF or 0 if SHF). In the model, sex was treated as a dummy variable (male = 1, female = 0); age, body mass index (BMI), and LVMI were numerical variables; RWT was treated as a dummy variable (expressed as 1 if RWT >0.42, 0 if otherwise); and histories of myocardial infarction, hypertension, and diabetes mellitus were each treated as dummy variables (expressed as 1 if there was a history, 0 if otherwise). Potential prognostic factors for DHF were assessed with a Cox proportional-hazards model. Finally, we estimated overall survival by the Kaplan—Meier method and tested for differences in survival between patients with DHF and those with