

BRIEF REPORT

## Meta-Iodobenzylguanidine Iodine-123 and Cardiac Adrenergic Activity in Familial Dilated Cardiomyopathy

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Familial dilated cardiomyopathy (FDCM) is characterized by genetic heterogeneity, incomplete age-dependent penetrance, and a multifactorial pathogenesis (1). Diagnosis is still dependent on clinical criteria and familial investigation (2). On the other hand, several abnormalities have been described among asymptomatic relatives, such as isolated left ventricle (LV) enlargement (3). These abnormalities could assist in identifying affected relatives, who are potential candidates for early therapeutic interventions. However, currently not even the presence of such abnormalities allows inferring carrier state or future progression of the disease. We hypothesized that

51 years). One of the families has the disease locus located in chromosome 7q22.3-31.1 (5). All participants underwent 12-lead electrocardiogram and 2-dimensional echocardiogram. Measurements were done according to the American Society of Echocardiography. Forty members also underwent cardiac magnetic resonance (CMR) on a 3-Tesla scanner (Magnetom trio, Siemens AG, Erlangen, Germany). The protocol included contrast-enhanced images, acquired 10 to 15 min after intravenous administration of gadobutrol (Gadovist [Schering AG, Berlin, Germany]; 0.2 mmol/kg). The  $^{123}\text{I}$ -*m*IBG imaging was performed after intravenous administration of 370 MBq (10 mCi) of  $^{123}\text{I}$ -*m*IBG (4). We used a dual-headed gamma camera (GE Millennium MG, Haifa, Israel), equipped with low-energy, high-resolution, parallel-hole collimators, using a 20% window centered at the 159-keV photo peak. Images were processed with dedicated software (QGS/QPS [Cedars-Sinai Medical Center, Los Angeles, California] on a Xeleris [Paris, France] workstation). No attenuation correction was performed. Anterior projection planar thoracic images were obtained 20 min and 4 h after tracer injection, and heart/mediastinal (H/M) ratio and myocardial washout rate (WR) calculated twice by 2 independent blinded observers. The final results were obtained by the mean of the average of each operator. A blood sample was obtained for B-type natriuretic peptide (BNP) quantification (Architect system, Abbott, Abbott Park, Illinois) just before  $^{123}\text{I}$ -*m*IBG administration. Heart rate variability parameters were calculated, using a DigiTrack-Plus Recorder (Philips Medical Systems, Andover,

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*meta*-iodobenzylguanidine iodine-123 ( $^{123}\text{I}$ -*m*IBG) imaging, a tool for monitoring sympathetic activity, could be useful in the evaluation of family members, as it reflects pathophysiologic mechanisms involved in disease progression (4). This evaluation could provide prognostic data useful in this clinical setting.

We evaluated 45 FDCM members from 23 families defined by the European Society of Cardiology criteria (2); 25 patients (56%) were male, with a median age of 43 years (interquartile range, 36 to

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## ABBREVIATIONS AND ACRONYMS

**BNP** = B-type natriuretic peptide

**CMR** = cardiac magnetic resonance

**EF** = ejection fraction

**FDCM** = familial dilated cardiomyopathy

**H/M** = heart/mediastinal

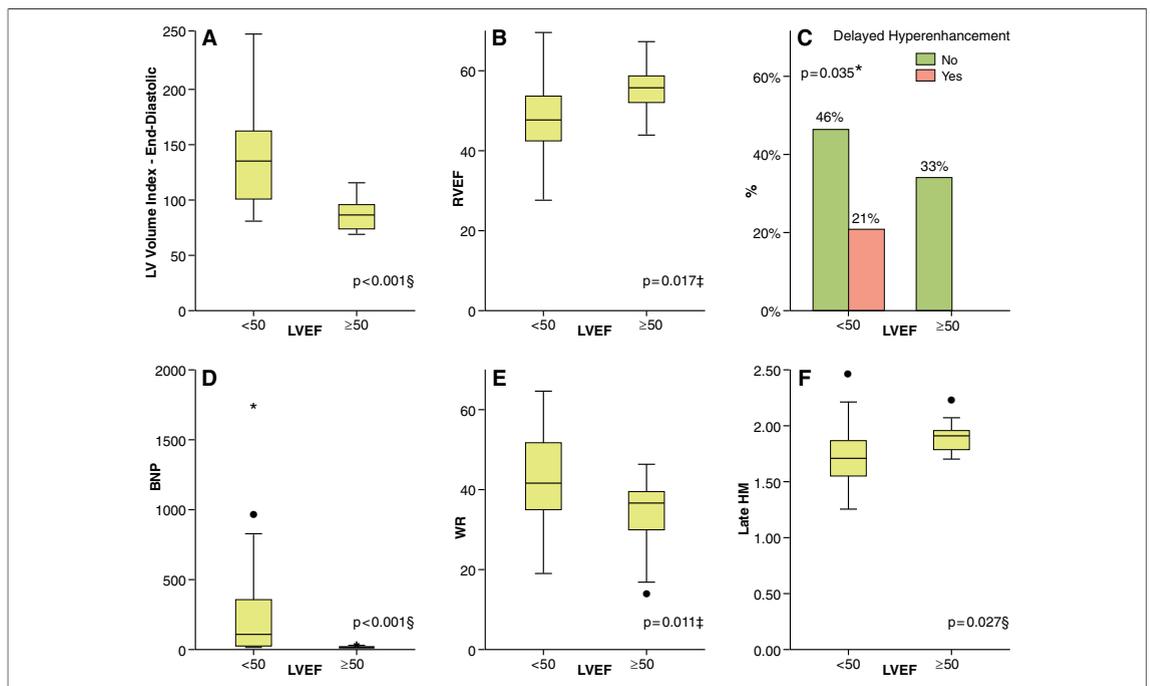
**LV** = left ventricular

**WR** = washout rate

Massachusetts) and a Philips Zymed Holter, Model 1810 Plus Software (Philips Medical Systems). All statistical analyses were performed with SPSS for Windows (version 16.0; SPSS Inc, Chicago, Illinois). Categorical data were compared using Fisher exact test. Student *t* and Mann-Whitney *U* tests were used to compare continuous variables. The Spearman correlation was used to evaluate associations in continuous variables with asymmetric distribution, such as LV mass index and LV ejection fraction (EF).

Twenty-nine familial members (64%) had EF <50% (DCM patients), and 16 had EF ≥50%, including 6 with reverse remodeling (previous LV systolic dysfunction) and 10 asymptomatic relatives. An expected difference between both groups was observed in CMR-indexed LV end-diastolic volumes (134 ml/m<sup>2</sup> [range 100 to 161] vs. 85 ml/m<sup>2</sup> [range 73 to 95]; *p* < 0.001), LVEF (30% [range 25% to 45%] vs. 55% [range 55% to 64%]; *p* < 0.001), right ventricular EF (48 ± 10% vs. 55 ± 7%; *p* = 0.017), late hyperenhancement (8 patients vs. none; *p* = 0.035), plasma BNP (104 pg/ml [range 18 to 354 pg/ml] vs. 10 pg/ml [range 10 to

16 pg/ml]; *p* < 0.001], myocardial WR (43 ± 11% vs. 34 ± 9%; *p* = 0.011), and late H/M ratio (1.73 ± 0.26 vs. 1.89 ± 0.14; *p* = 0.027) (Fig. 1). No heart variability parameter value was distinct between both groups. We did not find significant differences in WR value and late H/M ratio between members with (47.2 ± 11.3% and 1.6 [range 1.4 to 1.8], respectively) and without (40.2 ± 11.3% and 1.7 [range 1.6 to 1.9], respectively) delayed hyperenhancement on CMR (*p* = 0.16 and *p* = 0.22, respectively). The majority (55%) of DCM patients were in New York Heart Association functional class I, and 90% were treated with beta-blockers. In this group, WR was higher than 30% (≥2 SDs) in 24 (83%), and late H/M was inferior to 1.7 in 11 patients (38%). Myocardial WR and late H/M ratio were both correlated with BNP (*r* = 0.595, *p* = 0.01; *r* = -0.622, *p* = 0.01) (Fig. 2), LVEF (*r* = -0.668, *p* = 0.01; *r* = 0.685, *p* = 0.01), LV diastolic (*r* = 0.677, *p* = 0.01; *r* = -0.584, *p* = 0.01), and systolic (*r* = 0.743, *p* = 0.01; *r* = -0.660, *p* = 0.01) indexed volumes and LV indexed mass (*r* = 0.638, *p* = 0.01; *r* = -0.471, *p* = 0.05) on CMR imaging. In the group with normal LV systolic function, we found an abnormally high myocardial WR (>30%) in 11



**Figure 1. Comparison Between FDCM Patients and Relatives According to LVEF**

(A) Cardiac magnetic resonance (CMR) left ventricular (LV) end-diastolic volume, (B) CMR right ventricular ejection fraction (RVEF), (C) delayed hyperenhancement, (D) plasma B-type natriuretic peptide (BNP), (E) myocardial *meta*-iodobenzylguanidine iodine-123 (<sup>123</sup>I-mIBG) washout rate (WR), (F) <sup>123</sup>I-mIBG late heart to mediastinum activity ratio (H/M). \*Chi-square test, ‡Student *t* test for independent groups; §Mann-Whitney *U* test. FDCM = familial dilated cardiomyopathy; LVEF = left ventricular ejection fraction.

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