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Fat Deposition in Dilated Cardiomyopathy Assessed by CMR

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OBJECTIVES The aim of this study was to prospectively investigate the prevalence of fat deposition in idiopathic dilated cardiomyopathy (DCM) by fat-water separation imaging. An auxiliary aim was to determine the relationship between left ventricular (LV) fat deposition and characteristic myocardial fibrosis, as well as cardiac functional parameters.

BACKGROUND Idiopathic DCM remains the most common cause of heart failure in young people referred for cardiac transplantation; little is known about the clinical value of fat deposition in DCM.

METHODS A total of 124 patients with DCM were studied after written informed consent was obtained. The magnetic resonance imaging scan protocols included a series of short-axis LV cine imaging for functional analysis, fat-water separation imaging, and late gadolinium enhancement (LGE) imaging. Fat deposition and fibrosis location were compared to the scar regions on LGE images using a 17-segment model. Statistical comparisons of LV global functional parameters, fibrosis volumes, and fat deposition were carried out using the Pearson correlation, Student *t* test, and multiple regressions.

RESULTS The patients had a 41.9% (52 of 124) prevalence of positive LGE, and 12.9% (16 of 124) fat deposition prevalence was found in this DCM cohort. The patients with fat deposition had larger LV end-diastolic volume (LVEDV) index (140.8 $\pm$ 20.2 ml/m^2 vs. 123.4 $\pm$ 15.8 ml/m^2; $p < 0.01$), larger LV end-systolic volume (LVESV) index (111.3 $\pm$ 19.2 ml/m^2 vs. 87.0 $\pm$ 20.3 ml/m^2; $p < 0.01$), and decreased LV ejection fraction (LVEF) (21.1 $\pm$ 7.1% vs. 30.0 $\pm$ 10.7%; $p < 0.01$). Higher volumes of LGE were found in the group with myocardial fat deposition (18.39 $\pm$ 9.0 ml vs. 13.40 $\pm$ 6.54 ml; $p = 0.001$), as well as a higher percentage of LGE/LV mass (19.11 $\pm$ 7.78% vs. 13.60 $\pm$ 4.58%; $p = 0.000$). The volume of fat deposition was correlated with scar volume, LVEF, LVEDV index, and LVESV index.

CONCLUSIONS Fat deposition is a common phenomenon in DCM, and it is associated with DCM characteristics such as fibrosis volume and LV function. (J Am Coll Cardiol Img 2013;6:889–98)

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Idiopathic dilated cardiomyopathy (DCM) is a syndrome characterized by cardiac enlargement and global systolic dysfunction in the presence of normal arteries (1,2) that remains an important cause of systolic heart failure and the most common cause of heart failure in young people referred for cardiac transplantation (3). Histological characteristics include substantial hypertrophy and degeneration of myocytes, varying degrees of interstitial fibrosis, and occasional small clusters of lymphocytes and fibrofatty infiltration (4).

Many researchers have studied the clinical value of late gadolinium enhancement (LGE) in patients with DCM, and it was believed that LGE was an important prognostic indicator of DCM (5,6). However, it was impossible to separate fibrosis tissue from fat in conventional LGE images because both fat and fibrosis manifested as high signals. Until now, little research has focused on fat deposition in patients with DCM (7,8).

Myocardial fat demonstrates a hyperintense signal in conventional fast spin-echo images that becomes selectively hypointense in fat saturation fast spin-echo or short tau inversion recovery images. The first water-fat separation method was described by Reeder et al. (9) using steady-state free precession with the iterative decomposition of water and fat with echo asymmetry and least-squares estimation (IDEAL) technique. There have been many publications from this group regarding the IDEAL technique on fat detection (10–12). However, there is little research specifically focused on myocardial fat detected with this technique. In this study, we used the fat-sensitive magnetic resonance sequence fat-water separation using VARiable PROjection (VARPRO) (13) to investigate fat deposition in DCM. The aim of the present study was to prospectively investigate the prevalence of fat deposition in DCM by fat-water separation imaging and to determine the relationship between left ventricular (LV) fat deposition and characteristic myocardial fibrosis, as well as cardiac functional parameters.

ABBREVIATIONS AND ACRONYMS

CO = cardiac output

DCM = dilated cardiomyopathy

LGE = late gadolinium enhancement

LV = left ventricle/ventricular

LVEDV = left ventricular end-diastolic volume

LVEF = left ventricular ejection fraction

LVESV = left ventricular end-systolic volume

LVM = left ventricular mass

METHODS

Patient population. This study was approved by the institutional review board, and all patients gave written consent prior to study initiation. A total of 140 consecutive patients (all of Asian race) with a diagnosis of idiopathic DCM made within the preceding 2 weeks were enrolled in this study. Diagnosis was established by clinical examination, echocardiography, and normal coronary angiograms. The inclusion criterion was the presence of left ventricular ejection fraction (LVEF) ≤45% at baseline echocardiography or cardiac magnetic resonance (CMR) imaging. Exclusion criteria included the diagnosis of significant coronary artery disease (defined as the presence of 50% luminal stenosis in an epicardial coronary artery at angiography, noninvasive stress imaging suggestive of ischemia, history of previous coronary intervention, or prior myocardial infarction), severe valvular heart disease, thyroid dysfunction, infiltrative cardiomyopathy, extracardiac systemic features suggesting sarcoidosis or amyloidosis, heavy alcohol use (>90 g of alcohol per day), peripartum cardiomyopathies, chemotherapy-induced cardiomyopathy, hypertrophic cardiomyopathy, and myocarditis. Myocarditis was excluded in potential DCM cases by the absence of classic clinical features, presence of normal serum troponin I concentration at presentation, and lack of evidence of myocardial edema on T2-weighted CMR (14). Exclusion from the CMR examination was mandated by renal impairment (estimated glomerular filtration rate of 60 ml/min) or other conventional CMR contraindications.

CMR imaging protocol. All CMR examinations were performed with a 1.5-T scanner (Magneton Avanto, Siemens Medical Systems, Erlangen, Germany)

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