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Right bundle branch block and ventricular septal fibrosis in patients with hypertrophic cardiomyopathy

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Abstract

Background: Right bundle branch block (RBBB) is associated with ventricular septal fibrosis in patients with hypertrophic cardiomyopathy (HCM) after alcohol septal ablation, but little data are available in HCM patients without a history of septal ablation.

Methods: Magnetic resonance late gadolinium enhancement (LGE) was performed in 59 HCM patients with no history of alcohol septal ablation. The location and extent of LGE were examined in relation to electrocardiographic features including RBBB.

Results: LGE volume was higher in 7 HCM patients with RBBB (7.3 ± 7.4 g/cm) than in patients without RBBB (2.9 ± 7.4 g/cm, $p = 0.016$). LGE volume was positively correlated to QRS duration of RBBB (correlation coefficient = 0.93, $p = 0.023$). The diagnostic value of RBBB was highly specific for the detection of LGE in the ventricular septum, with sensitivity 21% and specificity 94%.

Conclusions: The presence of RBBB may be a simple marker for detecting ventricular septal fibrosis in HCM patients who had no history of alcohol septal ablation. Further studies are necessary to confirm our findings.

Keywords: Hypertrophic cardiomyopathy; Right bundle branch block; Myocardial fibrosis; Ventricular septum

Introduction

Myocardial fibrosis in the left ventricle often develops in patients with hypertrophic cardiomyopathy (HCM) in the absence of coronary stenosis [1,2]. Myocardial fibrosis is clinically detected by late gadolinium enhancement (LGE) magnetic resonance imaging [3,4] and has been reported to be associated with adverse cardiovascular events in patients with HCM [5–8]. LGE could be a promising technique for the management of HCM patients.

Some patients with HCM undergo alcohol septal ablation to relieve severe symptoms due to left ventricular outflow tract obstruction. Alcohol septal ablation is known to cause changes not only in anatomical structure (i.e., ventricular septal fibrosis) but also in the cardiac conduction system; right bundle branch block (RBBB) is the most common electrocardiographic change after this procedure [9–12]. More recently, a close association of RBBB with LGE in the ventricular septum was reported in patients with HCM who had undergone alcohol septal ablation [13]. This relationship may hold even in HCM patients with no history of alcohol septal ablation, but little data are available at present.

The objective of the present study was to test the hypothesis that the presence of RBBB could be a good marker for the detection of ventricular septal fibrosis in HCM patients with no history of alcohol septal ablation.

Methods

Study population

This retrospective study consisted of consecutive patients with HCM who were referred to our institute for LGE magnetic resonance imaging from March 2010 to May 2013. The diagnosis of HCM was based on the conventional echocardiographic demonstration of left ventricular end-diastolic thickness ≥ 15 mm in the absence of any cardiac or systemic disorder that could cause hypertrophy, such as severe hypertension defined as blood pressure ≥ 160/100 mm Hg or aortic stenosis defined as an aortic valve area < 1.5 cm^2. A total of 64 patients with HCM met our inclusion criteria. Of these, 2 patients were excluded because of a previous history of myocardial infarction. We excluded 3 patients in whom magnetic resonance imaging was discontinued because of

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possible side effects of gadolinium, difficulty in holding breath, or claustrophobia. Ultimately, the present study consisted of 59 patients with HCM (44 men; mean age, 62 ± 12 years). All patients were clinically stable; none of them had clinically significant valvular heart disease or renal dysfunction defined as an estimated glomerular filtration rate <60 ml/min/1.73 m^2. There were no patients treated with permanent mechanical device implantations, septal myectomy, alcohol septal ablation, or heart transplantation. Coronary heart disease was ruled out in all patients on the basis of conventional coronary angiography, multidetector computed tomography, magnetic resonance angiography, or exercise myocardial perfusion scintigraphy. Informed consent for this study was obtained from all patients with HCM.

Cardiac magnetic resonance

All patients underwent cardiac magnetic resonance imaging using a 1.5 tesla imaging system (Signa HDx, General Electric Medical Systems, Wisconsin, USA). Steady-state free procession of cine images was obtained in a long-axis view and short-axis views at basal, mid-, and apical left ventricular levels (slice thickness 7 mm, spacing 5 mm, and field of view 360 mm × 360 mm) [14,15]. Approximately 10 minutes after an intravenous injection of 0.1 mmol/kg gadopentetate dimeglumine (Magnevist, Schering AG, Berlin, Germany), LGE images were obtained in a long-axis view and in short-axis views at basal, mid, and apical left ventricular levels under serial breath-holds using a 2-dimensional, spoiled, and segmented inversion recovery and gradient-echo sequence [14,15]. Inversion time was selected using a standardized algorithm on the basis of myocardial and blood T1 values, heart rate, time of imaging from contrast injection, and dose of contrast. The following scan parameters were used: slice thickness 7 mm, spacing 5 mm, field of view 270 mm × 270 mm, flip angle 20 degrees, spatial resolution 1.6 mm × 2.3 mm, and number of averages 2.

The endocardial and epicardial borders and maximum wall thickness of the left ventricle were manually measured at the end-diastolic phase of cine short-axis views using commercially available software (Plissimo Ex Version 1.0.4.5, Panasonic Medical Solutions Co., Ltd., Osaka, Japan). Left ventricular mass was calculated from the total volume multiplied by 1.05 g/ml and indexed to height in cm [15,16]. LGE was defined as 2 standard deviations above the mean signal intensity of apparently normal myocardium [14–16]. The extent of LGE was assessed by the sum of enhanced areas on all short-axis images (LGE volume, expressed as g/cm) and by the proportion of left ventricular mass (percentage LGE, expressed as %) [15,16]. The location of LGE was determined according to a 17-segment model of the left ventricle, including 1 apex segment on a vertical long-axis view and 16 segments on 3 short-axis views [17].

Electrocardiographic analysis

Standard 12-lead electrocardiography was performed at rest in the supine position using a commercially available device (FCP-7431 or FCP-8800, FUKUDA DENSHI Co., Ltd., Tokyo, Japan; filter range, 0.05 to 150 Hz; AC filter off, muscle filter off, drift filter 0.5 Hz, 25 mm/s, 10 mm/mV). QRS duration and frontal plane QRS axis were automatically measured. RBBB was defined as a QRS duration ≥ 120 ms, rSR′ in lead V1 or V2, and S waves in lead I and either lead V5 or V6, as shown in Fig. 1; left bundle branch block was defined as a QRS duration ≥ 120 ms, predominantly upright

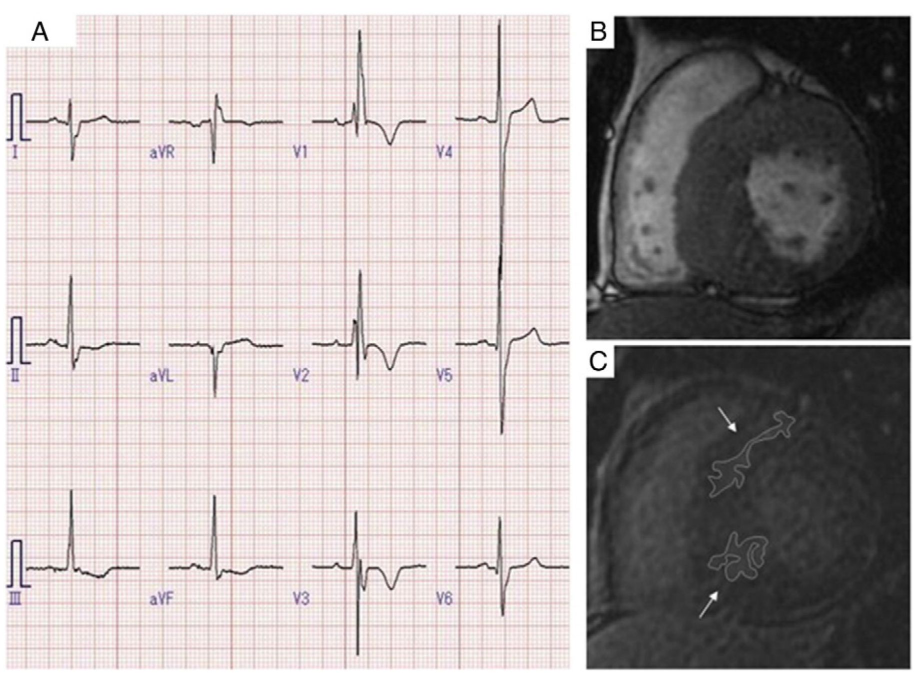

Fig. 1. Representative case (Case 2 in Table 2). Electrocardiogram shows right bundle branch block with a QRS duration of 157 ms (A). A cine image in the basal short-axis slice of the left ventricle at the end-diastolic phase shows asymmetric septal hypertrophy with a maximum wall thickness of 34 mm (B). Late gadolinium enhancement is present in the ventricular septum (C).