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Original Article

Changes over time in echocardiographic variables and atrial electromechanical intervals after ablation for atrial fibrillation

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ABSTRACT

Introduction: Acute and mid-term effects of ablation for atrial fibrillation (AF) on left atrial (LA) and left ventricular (LV) function and the atrial electromechanical interval are controversial.
Methods: Echocardiographic variables and the PA-TDI interval (time from ECG lead II P-wave onset to lateral a′ wave on tissue Doppler tracings, indicating the total atrial conduction time [TACT]) were evaluated in 33 paroxysmal AF patients before, 1 day, and 3, 6, and 12 months after ablation.
Results: During a 12-month follow-up, 10 (30.3%) patients had recurrent AF, associated with a greater baseline LA volume (LAV) (48.4 ± 19.3 mm^3 vs. 38.7 ± 11.4 mm^3, $P=0.0811$) and PA-TDI interval (163.9 ± 11.0 ms vs. 151.1 ± 14.6 ms, $P=0.0189$) than in patients without AF recurrence. By 6 months after ablation, LAV had decreased progressively in the non-recurrence group (27.9 ± 8.1 mm^3, $P<0.0001$ vs. baseline), but the decrease was modestly significant in the recurrence group (36.3 ± 7.5 cm^3, $P=0.0380$). LV ejection fraction (LVEF) modestly increased 1 day after ablation in both groups and remained unchanged in the non-recurrence group (67.9 ± 8.1% at baseline to 70.5 ± 5.9% at 12 months, $P=0.1711$), whereas it decreased gradually below the baseline value in the recurrence group (68.2 ± 11.3% to 60.9 ± 13.6%, $P=0.1025$). The PA-TDI interval did not change during follow-up in either group, but remained longer in the recurrence group.
Conclusions: The PA-TDI interval may be useful for predicting post-ablation AF recurrences. The patterns of time-course changes in LAV, LVEF, and TACT differ, but the effects of ablation were better in patients without AF recurrence after ablation.

1. Introduction

Over the past 10 years, pulmonary vein isolation (PVI) has been used as an effective therapy for atrial fibrillation (AF) [1]. Nevertheless, the progression of atrial electrical and structural remodeling requires additional aggressive ablation strategies, i.e., a complex fractionated atrial electrogram (CFAE) ablation and/or atrial linear ablation. Despite such treatments, the post-ablation AF recurrence rate is higher in patients treated aggressively for atrial remodeling than in patients with less extensive remodeling of the atria treated with PVI alone [2,3]. Determining the extent of structural and electrical atrial remodeling before ablation is relevant for selecting AF ablation strategies. Structural and electrical atrial remodeling are estimated by the left atrial (LA) size, volume (LAV), a shortened atrial refractory period, or a prolonged total atrial conduction time (TACT) [3–7]. Recently, the time interval in the electrocardiogram (ECG) lead II from onset of the P wave to the lateral mitral annulus a′ velocity wave, as assessed with tissue Doppler imaging (PA-TDI interval), has been shown to represent the electromechanical interval reflecting the TACT [6,8–10]. Therefore, we investigated whether this echocardiographic variable could be used to identify patients prone to AF recurrence following catheter ablation.

There is increasing evidence that the maintenance of sinus rhythm following AF ablation results in reversed structural and electrical remodeling of the atria during follow-up [4,11–15]. This study aimed to elucidate the short- and long-term effects of AF ablation on atrial and left ventricular function and the atrial electromechanical interval as assessed with standard and

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tissue Doppler-based echocardiography. Additionally, we sought to analyze the time course of the changes in these variables during the short- and mid-term follow-up periods after AF ablation.

2. Methods

2.1. Study patients

The study group comprised of 33 consecutive patients with paroxysmal AF (spontaneous termination within 7 days; 27 men, 6 women; mean age, 57.5 ± 9.5 years) referred to Nihon University Itabashi Hospital for a first radiofrequency catheter ablation. This study excluded patients with non-paroxysmal AF lasting > 7 days, and those undergoing repeat procedures. All patients provided written informed consent for the electrophysiologic study and ablation procedure. This study was approved by the medical ethics committee of our institution (date of approval: Sep 9th, 2011, approval no. RK-110909-2). Adequate oral anticoagulation was administered for at least 1 month before the procedure. All antiarrhythmic drugs were discontinued for at least 5 half-lives prior to the ablation. Upon hospital admission, a medical history, physical examination, 12-lead ECG, chest radiograph, and transesophageal and transthoracic echocardiograms were obtained. All patients underwent multi-slice computed tomography on a 320-row detector, dynamic volume scanner (Aquilion ONE; Toshiba Medical Systems, Tokyo, Japan) to obtain a 3-dimensional reconstruction of the left atrium and pulmonary veins (PVs).

2.2. Electrophysiologic study and ablation procedure

The procedure was performed under intravenous sedation with propofol and fentanyl as previously described [3]. In brief, after vascular access was obtained, a single transseptal puncture was performed and followed by extensive ipsilateral PVI, guided by double Lasso catheters and by using a 3-dimensional geometric map generated by a NavX (St. Jude Medical, St. Paul, Minnesota) or CARTO (Biosense Webster, Inc., Diamond Bar, California) mapping system [1–3]. A 3.5-mm irrigated-tip catheter (ThermoCool, Navistar, Biosense Webster) was used for ablation. Radiofrequency energy was delivered at a maximum power output of 30 W, and the upper temperature limit was set to 41 °C at a saline irrigation rate of 17 mL/min (CoolFlow Pump; Biosense Webster). The endpoint of PVI was the elimination or dissociation of all PV potentials and the

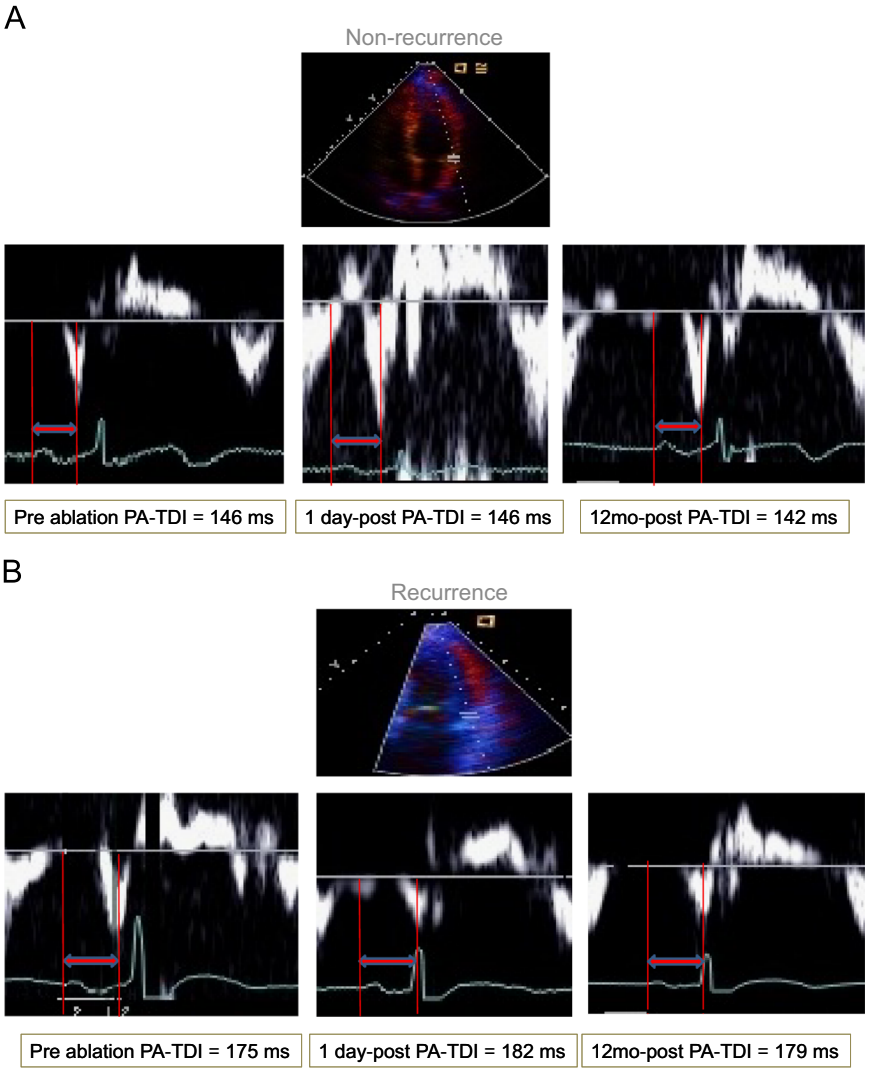

Fig. 1. Examples of the measurement of the PA-TDI interval in patients without (A) and with (B) recurrence of atrial fibrillation after ablation. Upper image shows an apical 4-chamber view and the lower images show tissue Doppler tracings. The PA-TDI is measured as the time interval from the onset of the P wave in ECG lead II to the peak a´ wave of the left lateral atrial wall on the tissue Doppler tracing. The mean PA-TDI intervals in the patient with no AF recurrence are 146 ms before ablation, 146 ms on day 1 after ablation, and 142 ms at 12 months after ablation; in the patient with recurrence, the mean PA-TDI intervals are 175 ms before ablation, 182 ms on day 1 after ablation, and 179 ms at 12 months after ablation.