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Prevalence, risk, and benefits of radiofrequency catheter ablation at the aortic cusp for the treatment of mid to anteroseptal supra-ventricular tachyarrhythmias

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ABSTRACT

Background: Some outflow tract ventricular tachycardias (VTs) are known to be successfully ablated from the aortic cusp (AC). However, radiofrequency catheter ablation (RFCA) at the AC for the treatment of supraventricular tachyarrhythmia (SVT) has limited experience.

Methods: We performed RFCA at the AC in 19 patients (male 64.7%, 46.9 ± 21.9 years old) with mid- to anteroseptal SVTs (12 atrial tachycardias [AT], 7 atrioventricular reciprocating tachycardia [AVRT]), and analyzed the prevalence, electrophysiologic findings, clinical outcome, and compilation risk.

Results: 1. Among 113 patients with AT, 13 patients had mid- to anteroseptal AT and 12 patients (8.8%, 53.4 ± 19.8 years old, 58.3% female) underwent successful ablation from the non-coronary cusp (NCC; n = 10), right CC (RCC; n = 1) or left CC (LCC; n = 1) without complication (3.1 ± 2.3 times RF delivery, 6.15 ± 3.08 s for termination). During 19.7 ± 9.8 months of follow-up, AT recurred in a patient with multiple foci. 2. Among 580 patients with AVRT, 27 patients had a mid- to anteroseptal bypass tract (4.7%), and 7 of them (1.1%, 2 pre-excitation syndrome, 5 concealed bypass tract) were successfully ablated at the NCC (n = 2) or RCC (n = 5) (7.0 ± 7.1 times RF delivery, 9.1 ± 4.4 s for termination). Among 5 patients with AVRT successfully ablated at the RCC, one patient developed complete heart block 48 h after procedure, and 2 patients recurred AVRT or delta-wave in ECG during 13.9 ± 11.7 month follow-up.

Conclusion: Catheter ablation within the AC is an effective procedure to eliminate mid- to anteroseptal SVTs. However, RFCA on RCC requires a caution for heart block in our limited experience.

1. Introduction

Most arrhythmias induced by automaticity or triggered activity originate from embryologic raphe structures such as a junction between a vessel and the myocardium or between an annulus and the myocardium [1]. Atrial fibrillation (AF) is commonly triggered by the ectopies from a junction between the left atrium (LA) and pulmonary vein [2], and right ventricular outflow tract ventricular tachycardia (VT) sometimes originates from a junction between pulmonary artery and pulmonary valve [3,4]. Coronary sinus ostium is a common site of ectopic atrial tachycardia [5], and some VTs originate from the aorto-mitral continuity [6]. An aortic cusp (AC) is one of embryologic raphe structures and an excellent target for catheter ablation of some VTs originating from the left ventricular outflow tract (LVOT) because it allows good contact and stable position of the catheter [7,8]. However, radiofrequency catheter ablation (RFCA) of supraventricular tachyarrhythmias (SVTs) is rarely performed at the AC in patients with atrial tachycardia (AT) [9,10] or atrioventricular reciprocating tachycardia (AVRT) [11–15]. Recently, it was reported that aortographically determined anatomical position of AC and their electrogram pattern lead to safe and effective catheter ablation [16]. Therefore, we hypothesized that the AC can be an appropriate target for RFCA in patients with mid- to anteroseptal SVTs, including AT and AVRT. The purpose of this study was to evaluate the prevalence, effectiveness and risk of RFCA at the AC for the treatment of mid- to anteroseptal SVTs.

2. Methods

2.1. Patient selection

The study protocol was approved by the Institutional Review Board of Severance Cardiovascular Hospital, Yonsei University Health System and Korea University Cardiovascular Center, Korea University. All patients provided written informed consent. From January 2009 to June 2010, there were 113 patients with AT, 580 patients with AVRT, and 320 patients with AF who underwent catheter ablation in two institutions. Among them, we included 19 patients who successfully underwent RFCA at the AC for SVT in this study. The mean age was 46.9 ± 21.9 years old, and 64.7% were male patients.

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2.2. Electrophysiological mapping

Intracardiac electrograms were recorded using a Prucka CardioLab™ Electrophysiology system (General Electric Health Care System Inc., Milwaukee, WI, USA). A decapolar catheter (Bard Electrophysiology Inc. Lowell, MA, USA) was positioned in the high right atrium (RA), and a duo-decapolar catheter (St. Jude Medical Inc., Minnetonka, MN, USA) was inserted via the femoral vein and positioned inside the coronary sinus (CS) and the low RA. A quadripolar catheter was also placed in the His bundle recording region (Fig. 1A). We induced tachycardia by programmed electrical stimulations. After documenting narrow QRS tachycardias, differential diagnosis was performed by atrial or ventricular extra-stimulations, atrial or ventricular entrainment pacing, or para-Hisian pacing. In cases with para-Hisian AT or AVRT, we mapped the right antero-septum first, and then the left mid to antero-septum after performing a trans-septal puncture with Schwartz left (SL) 3 sheath (St. Jude Medical Inc., Minnetonka, MN, USA). If both right and left mid-septum were not appropriate for mapping or RF energy delivery due to the risk of heart block, ascending aortogram was performed in the left anterior oblique (LAO) 35° and right anterior oblique (RAO) 35° views with a 5Fr pig tail catheter (6 Fr, A&A Medical Device Inc. Gyeonggi-do, Republic of Korea; power injection of contrast media 25 mL/s), and then AC was mapped. In a patient who underwent AT ablation at the AC after AF ablation, 3-dimensional (D) electroanatomical mapping (CARTO-XP, Johnson & Johnson Inc. Diamond Bar, CA, USA) was performed.

2.3. Radiofrequency catheter ablation at AC

We conducted AC ablation in patients who satisfying following criteria: 1) visible His potential at potential target site on both right or left mid-septum, or 2) the best target site on AC without visible His potential after mapping of right and left side septum. After confirming the locations of AC and ostia of the right and left coronary arteries, we mapped the target site of tachycardia at the same fluoroscopic angles to the ascending aortograms. We mapped each AC with a 7Fr quadripolar 5 mm-tip deflectable ablation catheter (Boston Scientific Inc. USA.), and delivered RF energy to the potential target sites (50 W, 60 °C, for 60 s; Stockert generator, Biosense Webster Inc.; Diamond Bar, CA, USA.). To minimize the risk of heart block, we paced the high RA with 400–500 ms by monitoring the AH interval for prolongation or for junctional ectopic rhythm during RF energy delivery (Figs. 1C and 4C). In patients with AC origin AT, we started ablating during tachycardia at a low power energy setting (10 W, 50 °C) to define the right ablation site. As soon as AT was terminated by ablation, we stopped RF energy delivery, defined intact AH interval, and ablated it again with high RA pacing to ensure safety. In 2 patients with paroxysmal AF, AT originated from the non-coronary cusp (NCC) was sustained after bi-antral ablation and electrical isolation of 4 pulmonary veins. In one of these patients, we localized the AT focus on the AC and His potential recording area with 3D electroanatomical mapping (CARTO-XP, Johnson & Johnson Inc. Diamond Bar, CA, USA), and successfully ablated it (Fig. 2). In the other patient, AT was successfully ablated at AC with conventional mapping. After successful catheter ablation, we measured the distances between the target ablation site and right or left coronary artery ostia in RAO 35° and LAO 35° views by off-line analysis.

2.4. Patient follow-up

Patients were asked to visit the outpatient clinic 1, 3, 6, and 12 months after RFCA for follow-up. Electrocardiography (ECG) was performed at every visit, and Holter ECG and/or their event recorder was evaluated 3 months after RFCA or at anytime the patient reported palpitations. Patients were also advised to call a clinician or visit the outpatient clinic whenever they experienced symptoms suggestive of an arrhythmia.

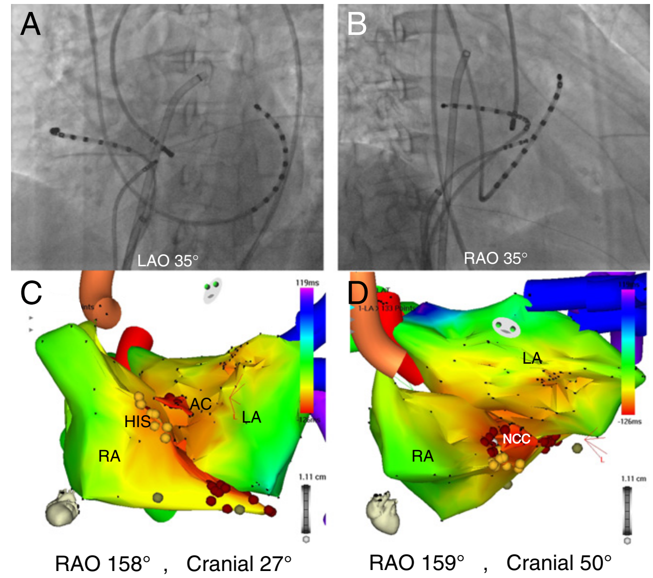

Fig. 2. A and B. Catheter position of the NCC ablation in RAO and LAO views. C and D. Color activation maps during AT of AC origin (CARTO-XP). Yellow balls mark the location of the His potential recording area, and an orange plate represents the NCC. The distance between the His potential recording area and the NCC was less than 10 mm.

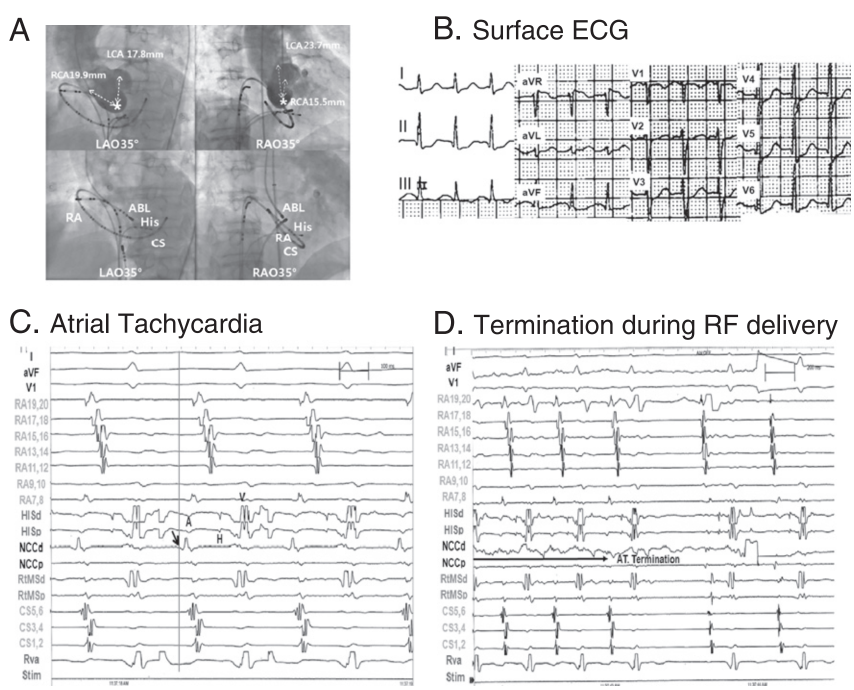

Fig. 1. A. Comparison of ascending aortogram and catheter position at successful ablation site in LAO 35° and RAO 35° fluoroscopic angles. Asterisk indicates successful ablation site and the distance from the ostia of coronary arteries were measured. LCA; left coronary artery, RCA; right coronary artery. B. Surface ECG of AT originated from the NCC. C. Activation mapping during AT. D. Termination of AT during RF energy delivery to the NCC. RtMSd stands for the distal electrode of mapping catheter on right atrial mid-septum. ABL; ablation catheter, His; His catheter, CS; coronary sinus, RA; right atrium.