Case Report

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Spontaneous Transition of Double Tachycardias with Atrial Fusion in a Patient with Wolff-Parkinson-White Syndrome

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Among patients with Wolff-Parkinson-White syndrome, atrioventricular reciprocating tachycardia (AVRT) and atrioventricular nodal reentrant tachycardia (AVNRT) can coexist in a single patient. Direct transition of both tachycardias is rare; however, it can occur after premature atrial or ventricular activity if the cycle lengths of the two tachycardias are similar. Furthermore, persistent atrial activation by an accessory pathway (AP) located outside of the AV node during ongoing AVNRT is also rare. This article describes a case of uncommon atrial activation by an AP during AVNRT and gradual transition of the two supraventricular tachycardias without any preceding atrial or ventricular activity in a patient with preexcitation syndrome. **(Korean Circ J 2016;46(4):574-579)**

KEY WORDS: Tachycardia, atrioventricular nodal reentry; Tachycardia, reciprocating; Tachycardia, paroxysmal; Tachycardia, supraventricular; Wolff-Parkinson-White syndrome.

Introduction

Dual atrioventricular (AV) nodal physiology is a common finding during electrophysiologic studies (EPS). Even among patients with Wolff-Parkinson-White (WPW) syndrome, atrioventricular nodal reentrant tachycardia (AVNRT) and atrioventricular reciprocating tachycardia (AVRT) can coexist in a single patient. However, direct transition of AVNRT and AVRT is quite rare. Retrograde atrial activation sequences during ventricular pacing and reentrant tachycardia provide important information for the localization of accessory pathways (APs).[1] Here, we report a case of double tachycardia with direct transition and eccentric retrograde atrial activation during typical AVNRT.

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Case

Clinical history

A 42-year-old male presented with recurrent palpitations for the last 10 years. The 12-lead electrocardiogram was normal, and echocardiography showed no significant structural abnormalities. Holter monitoring and an exercise test revealed intermittent preexcitation, suggesting a left-sided AP (Fig. 1). As the patient was highly symptomatic, EPS and possible radiofrequency catheter ablation (RF ablation) were recommended.

Electrophysiologic study

EPS was performed with a steerable duo-decapolar catheter positioned in the right atrium and inside the coronary sinus (CS), and two quadripolar catheters positioned at the right ventricular apex and the His bundle region. Basic intervals were normal. Dual AV nodal physiology was demonstrated by single atrial extra-stimulation. Anterograde conduction via an AP was not observed. At a driving pacing cycle length (CL) of 600 msec, the effective refractory periods (ERPs) of the fast and slow AV nodal pathways were 430 msec and 320 msec, respectively. During incremental ventricular pacing, 1:1 ventriculoatrial (VA) conduction over the AP in the left free wall occurred at 280 msec. The ERP of retrograde VA conduction over the AP was 250 msec and the ERP of retrograde VA conduction over the AV node was less than 230 msec.

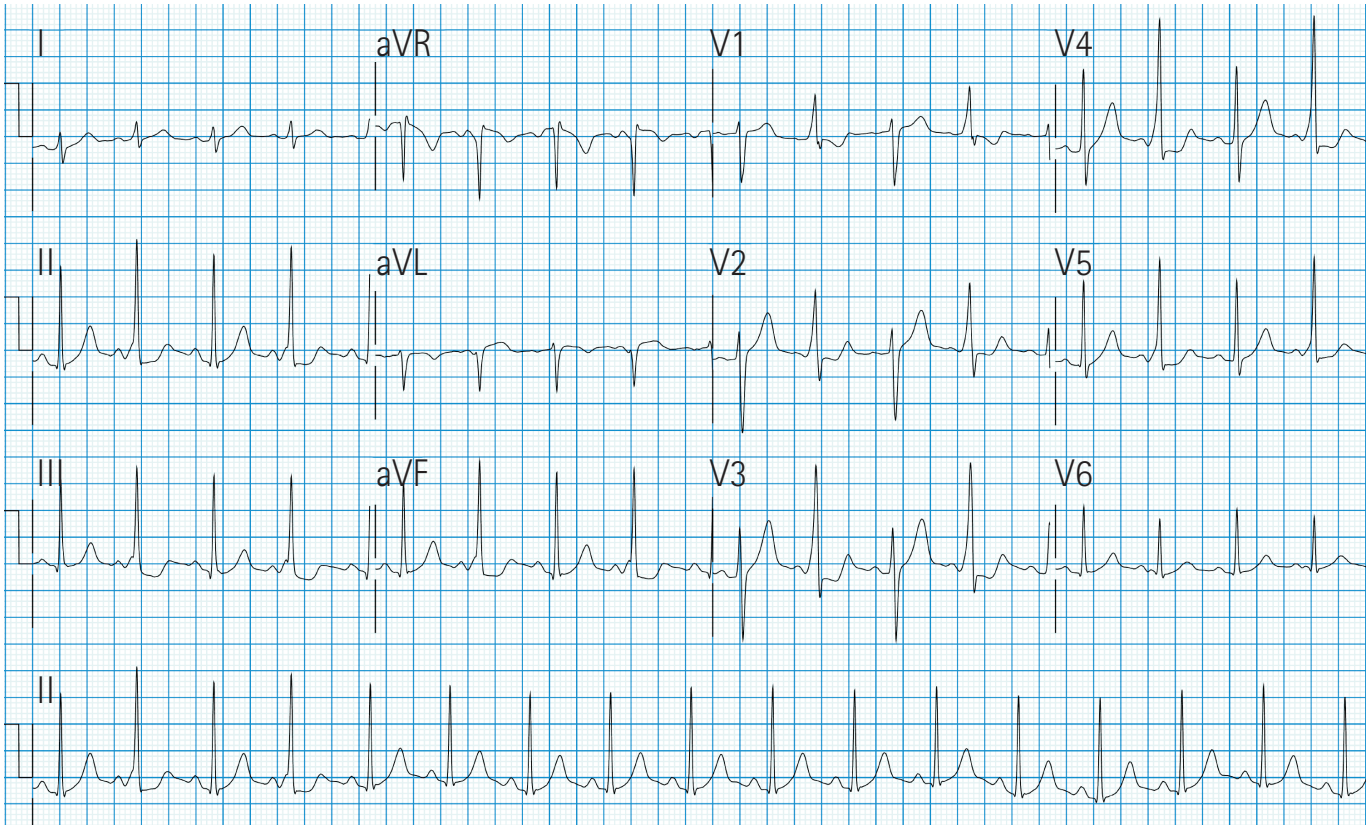

Fig. 1. A 12-lead electrocardiogram. Intermittent preexcitation was noted in the late recovery phase during the treadmill test. Delta wave polarity suggested an accessory pathway in the left free wall.

Tachycardia characteristics

Tachycardia with CL varying from 393 to 420 msec was reproducibly induced by single atrial extra-stimulation with AH prolongation (Fig. 2). The AH and HV intervals were 284 msec and 53 msec, respectively. The shortest VA interval of 56 msec was noted in the proximal CS recording. The sequence of retrograde atrial activation was eccentric, suggesting atrial fusion. Changing the site of earliest retrograde atrial activation to the distal CS with single premature ventricular pacing during tachycardia at a time of His-bundle refractoriness hindered discrimination of tachycardia (Fig. 3).

With slight prolongation of CLs of the tachycardia, there was transition of tachycardia to the other type of tachycardia with a CL ranging from 479 to 505 msec. The AH interval was 356 msec and the HV interval was 59 msec. Retrograde atrial activation was eccentric and the shortest VA interval was 70 msec in the distal CS recording (Fig. 2).

Mapping and radiofrequency catheter ablation

A 4-mm deflectable tip ablation catheter (Irvine Biomedical, Inc., Irvine, CA, USA) was used to deliver RF current with 40 W power and temperature limit of 60°C. After ablation of the AP in the left free wall (Fig. 4), VA conduction over the AV node was recorded and AVNRT with concentric retrograde atrial activation was reproducibly induced by single atrial extra-stimulation with AH jump (Fig. 5). Successful slow pathway modulation was achieved with an anatomic approach (Fig. 4).

Discussion

Multiple supraventricular tachycardias with multiple reentry circuits are relatively common in a patient during EPS. However, direct transition between double tachycardias is rarely observed. Delacretaz et al.[2] reported a case of direct transition from AVNRT to AVRT, and Rakovec[3] described a patient with WPW syndrome, in whom transition occurred from AVRT into AVNRT. Kuo et al.[4] reported 3 cases of double tachycardia with transition. In their report, Kuo et al.[4] proposed that similarity in tachycardia CLs may predispose to transition and the cutoff point of 25 msec had 80% positive predictive value for transition between double tachycardias. Usually, transitions were induced by premature beats or block of the AV nodal pathway or APs.

In the present case, tachycardia CLs of the two tachycardias

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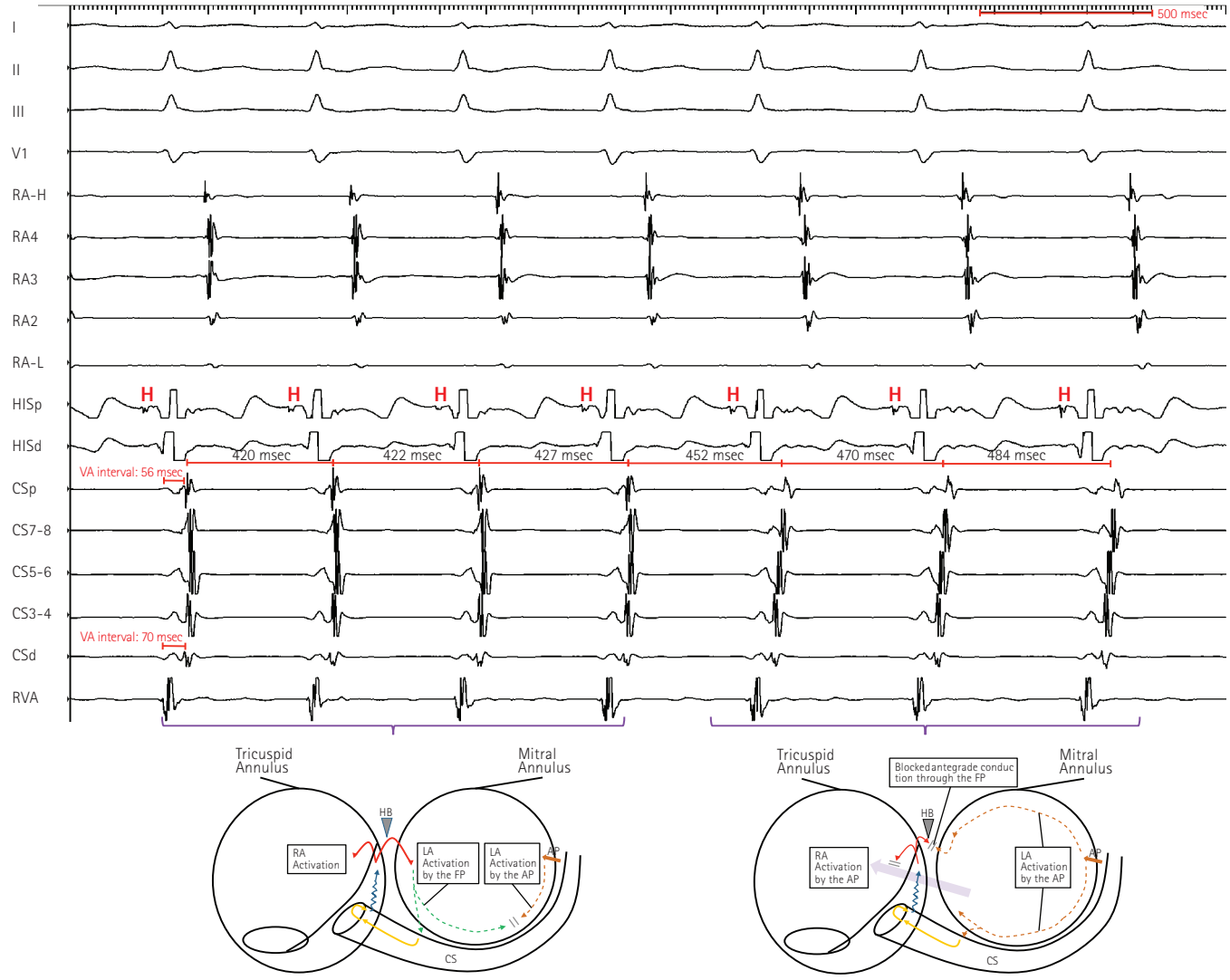

Fig. 2. Induced tachycardia (upper) and schematic drawing of atrial activation (below). Fusion of the sequence of retrograde atrial activation with slight lengthening of the tachycardia CLs, followed by transition to AVRT using the left free wall accessory pathway. The VA interval of 70 msec measured in the distal CS recording was constant. CL: cycle length, AVRT: atrioventricular reciprocating tachycardia, VA: ventriculoatrial, CS: coronary sinus, RA-H: right atrium high, RA-L: right atrium low, HISp: His-bundle electrogram proximal, HISd: His-bundle electrogram distal, CSp: coronary sinus proximal, CSd: coronary sinus distal, RVA: right ventricle apex, LA: left atrium, AP: accessory pathway.

were quite different and the difference was greater than 25 msec. Transition occurred with slight prolongation or shortening of the tachycardia CLs, rather than being induced by premature activities in the atria or ventricles.

Spontaneous tachycardia transition without premature activities is a rarely observed phenomenon. Delacretaz et al.[2] reported a case with transition without premature beats. However, an AP was located in the right posterior region relatively proximal to the AV nodal region and the difference in the CL of the tachycardia was less than 25 msec. In contrast, AVRT using the left lateral AP as a retrograde limb of the circuit was far distal to the AV node in this particular patient. Therefore, it is difficult to expect spontaneous transition of AVNRT or atrial fusion with the retrograde fast pathway.

The following factors might have contributed to or may have facilitated the spontaneous transition of tachycardia in the present patient: 1) Anterograde or retrograde AV nodal conduction may be influenced by the preceding cycle length or autonomic tone.[5] Intense variation of tachycardia CL and VA intervals was observed around the time of transition. 2) Although spatial distance of the AP was relatively far from the AV node, VA interval in the left free wall region (70 msec) was similar to that in the proximal CS recording (56 msec). 3) Atrial fusion continued during AVNRT. 4) Anterograde conduction of both tachycardias was transmitted through the

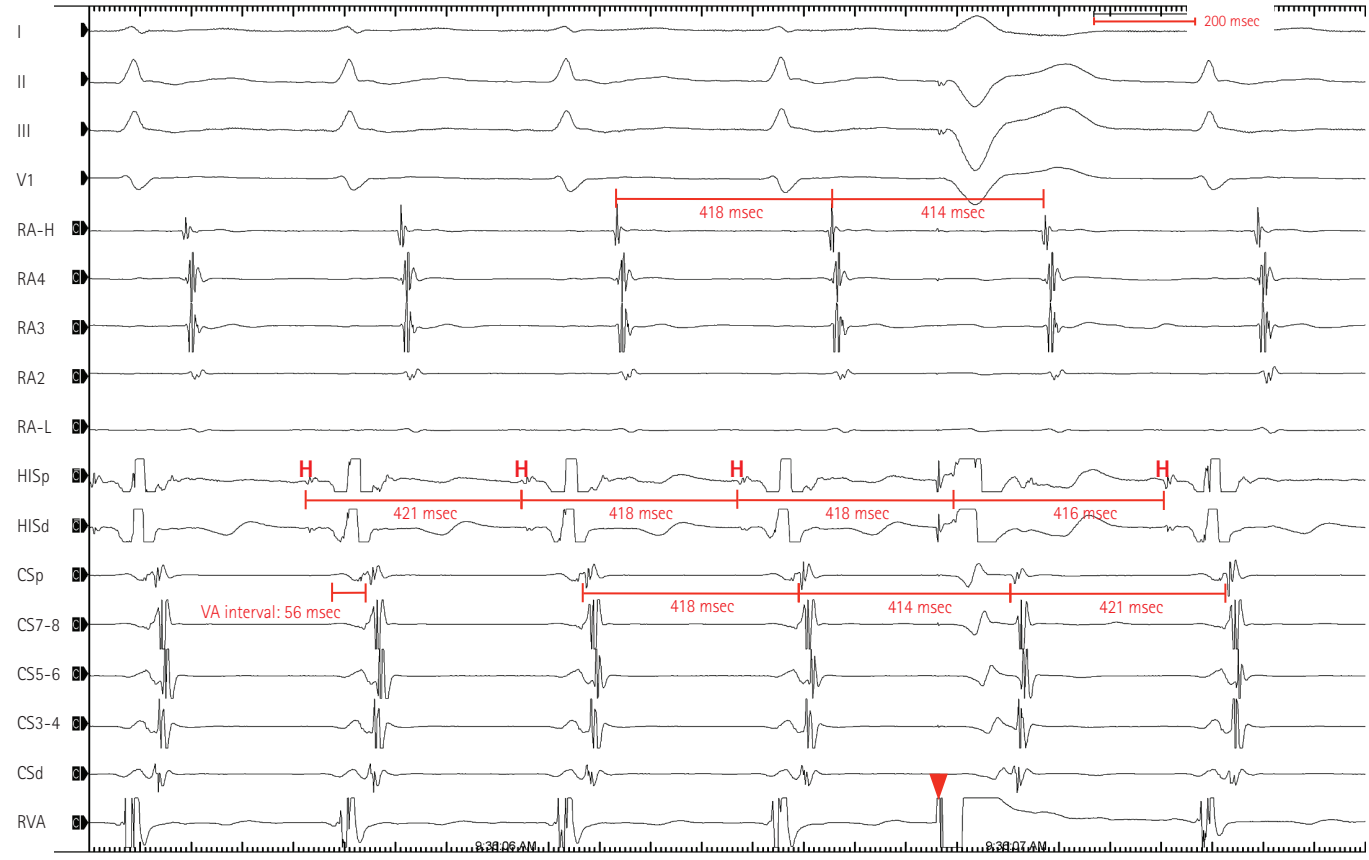

Fig. 3. His-synchronous ventricular extrastimulation. Although the short VA intervals in the proximal CS region suggested AVNRT, atrial activation was advanced (418 msec to 414 msec) with single premature ventricular pacing at a time of His-bundle refractoriness (arrowhead). VA: ventriculoatrial, CS: coronary sinus, AVNRT: atrioventricular nodal reentrant tachycardia.

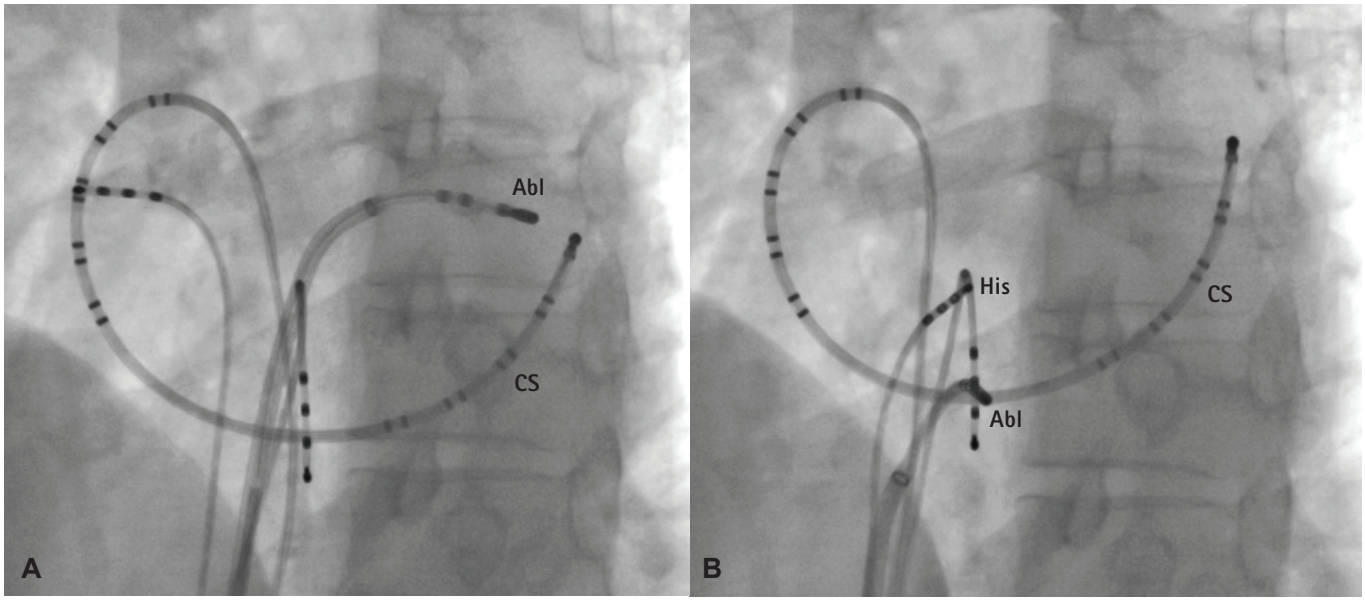

Fig. 4. Fluoroscopic imaging of the ablation site. Left anterior oblique fluoroscopic views of the successful radiofrequency catheter ablation site at the anterolateral aspect of the mitral annulus via a transseptal approach (A) and at the triangle of Koch for slow pathway modulation (B). Abl: ablation catheter, CS: coronary sinus.

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Fig. 5. Induction of tachycardia by single atrial extra-stimulation (A1A2 600/360 msec) after the AP ablation. The retrograde atrial activation sequence was concentric, suggesting typical slow-fast AVNRT. Note splitting of the VA interval in the distal CS recording in comparison with that in Fig. 2. RA-H: right atrium high, RA-L: right atrium low, HISp: His-bundle electrogram proximal, HISd: His-bundle electrogram distal, CSp: coronary sinus proximal, CSd: coronary sinus distal, RVA: right ventricle apex, LA: left atrium, AP: accessory pathway, AVNRT: atrioventricular nodal reentrant tachycardia, VA: ventriculoatrial, CS: coronary sinus.

slow pathway. However, the exact circuit of AVNRT remains unelucidated. Also, it is difficult to postulate the mechanisms underlying tachycardia transition in complicated AVNRT. Further research should be conducted.

The possibilities for unusual CS activation during narrow QRS tachycardia include multiple APs, atypical AVNRT,[6] left superior AP,[7] and intra-atrial block.[8] Eccentric atrial activation sequences during AVNRT, which was an unexpected type of tachycardia in a patient with WPW syndrome, were caused by the left lateral AP in this patient. Also, the retrograde atrial activation sequences were changed with direct transition of tachycardia. These findings were prone to misinterpretation regarding the retrograde sequence of atrial activation and led us away from the correct diagnosis. This instructive case emphasizes the need for careful interpretation of retrograde atrial activation sequences in the CS region in order to correctly identify the presence and location of APs.

In summary, we described a rare case of direct transition between AVNRT and AVRT in a patient with WPW syndrome. Fusion of retrograde activation of the atrium occurred via the fast pathway and the AP caused eccentric AVNRT. This case highlights the importance of the retrograde atrial activation sequence in the localization of APs and suggests that differential pacing maneuvers are not feasible in transitional tachycardia with atrial fusion.

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