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Unmasking of a concealed slow pathway by atrioventricular simultaneous basic pacing

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Abstract A 71-year-old woman with narrow QRS tachycardia was referred for catheter ablation. The clinical tachycardia was diagnosed as slow/fast form of atrioventricular (AV) nodal reentrant tachycardia (AVNRT) with the upper common pathway. Although neither conventional nor double atrial programmed extrastimulation (APS) showed any evidence of a dual AV nodal pathway, AV simultaneous pacing during basic stimulation preceding APS (AVSP-APS) reproducibly revealed a dual AV nodal pathway as a double ventricular response. The AVSP-APS pacing method may be helpful to unmask a "concealed slow pathway" in patients with AVNRT.

Keywords: Atrioventricular nodal reentrant tachycardia; Atrioventricular simultaneous basic pacing; Concealed retrograde penetration; Double ventricular response; Peeling back phenomenon

Case presentation

A 71-year-old woman without structural heart disease presented with intermittent palpitations. Her baseline electrocardiogram showed sinus rhythm without apparent evidence of pre-excitation. Neither conventional atrial programmed extrastimulation (APS) nor double APS showed evidence of a dual atrioventricular (AV) nodal pathway, and ventricular straight pacing showed no evidence of ventriculo-atrial conduction. A ventricular premature contraction consistently initiated a clinical tachycardia (Fig. 1A, B) during isoproterenol infusion. The clinical tachycardia showed an A-A interval of 560 ms and an H-H interval of 570 ms, and the atrial excitation sequence of the tachycardia was the same as that of the sinus rhythm. Supraventricular tachycardia with AV dissociation was suspected.

Atrial overdrive pacing during the clinical tachycardia was performed at a pacing cycle length of 530 ms (Fig. 1C). The atrial pacing interval determined the H-H and R-R intervals, where the P-R interval (570 ms) was longer than the atrial pacing interval. This indicated that atrial pacing had captured the antegrade slow pathway, and the response of the first return electrogram after cessation of atrial pacing was an "A-H-sinus excitation" but not an A-H-H-A. This confirmed the diagnosis of the slow/fast form of AV nodal reentrant tachycardia (AVNRT) and distinguished it from junctional tachycardia [1]. The coexistence of AV dissociation and AVNRT could be explained by the presence of the upper common pathway and its conduction block, which permits ventriculo-atrial block during AVNRT [2]. The "A-H-sinus excitation" response was considered to be concordant with an "A-H-A," which was masked by AV dissociation due to the block at the level of the upper common pathway (Fig. 1C, schematic ladder diagram).

Neither conventional nor double APS showed any evidence of a dual AV nodal pathway during sinus rhythm (Fig. 2A, B). However, AV simultaneous pacing during basic stimulation preceding APS (AVSP-APS) [3] reproducibly revealed two ventricular excitations, both of which were preceded by the H wave in the range of the extrastimulus interval (340 to 420 ms), resulting in a double ventricular response and 1 echo beat (Fig. 2C, D). AVSP-APS unmasked the "concealed slow pathway" and confirmed the existence of a dual AV nodal pathway.

Commentary

The mechanism of the double ventricular response can be explained as follows. During conventional APS, antegrade slow pathway conduction collided with the effective refractory period (ERP) of the slow pathway formed by the antegrade fast pathway conduction derived from atrial basic pacing (Fig. 3A). During AV simultaneous basic pacing,

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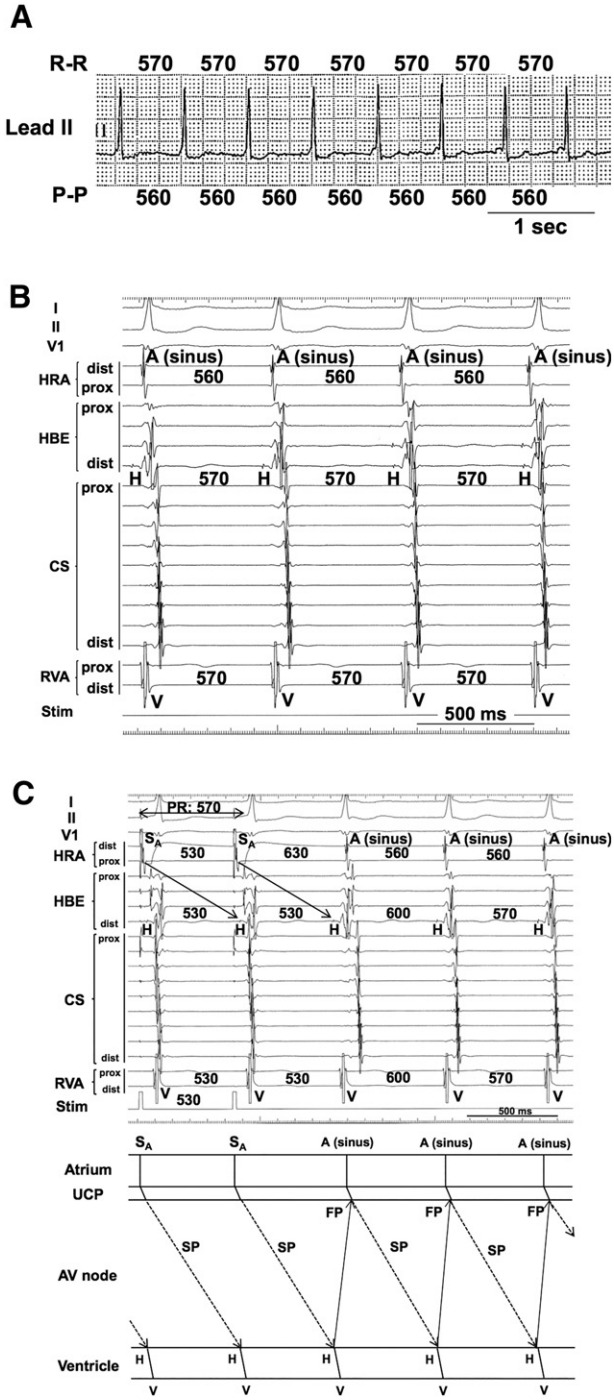

Fig. 1. Electrocardiogram and intracardiac electrogram of the clinical tachycardia. A) Lead II of the electrocardiogram. B) Intracardiac electrogram with stabilized A-A and H-H intervals. The A-A interval (560 ms) was concordant with the P-P interval of Panel A, the H-H interval (570 ms) was concordant with the R-R interval, and the atrial excitation sequence was concordant with sinus rhythm. C) Atrial overdrive pacing during the clinical tachycardia (pacing cycle length of 530 ms). Atrial pacing captured the antegrade slow pathway, and response of the first return electrogram after cessation of atrial pacing was an "A-H-sinus excitation," which was concordant with an "A-H-A" masked by AV dissociation at the level of the upper common pathway as in the schematic ladder diagram. This suggested that the diagnosis of the clinical tachycardia was AVNRT but not junctional tachycardia (See text for detail). HRA: high right atrium, HBE: His bundle electrogram, CS: coronary sinus, RVA: right ventricular apex, Stim: stimulation, prox: proximal, dist: distal, FP: fast pathway, SP: slow pathway, UCP: upper common pathway.

the ERP of the slow pathway was advanced due to the "peeling back" phenomenon [4]. Within a range of atrial extrastimulus intervals, antegrade slow pathway conduction can avoid colliding with the ERP of the slow pathway. In addition, retrograde slow pathway conduction derived from the antegrade fast pathway conduction (concealed retrograde penetration) diminished the conduction velocity because the slow pathway was in its relative refractory period [5]. This concealed retrograde penetration caused the antegrade slow pathway conduction delay (Fig. 3B) [6] such that AVSP-APS could manifest the slow pathway conduction as a double ventricular response. Notably, the A-H interval of the