Accessory pathway potential recording in a case of permanent junctional reciprocating tachycardia with decremental conduction localized on the atrial site

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Permanent junctional reciprocating tachycardia (PJRT) is an uncommon form of atrioventricular reentrant tachycardia due to the presence of an accessory pathway characterized by slow and decremental retrograde conduction. We report a case of PJRT where we demonstrated the possibility of recording a distinct accessory pathway potential. Decremental retrograde conduction was evident using ventricular extrastimuli and it was also adenosine-sensitive. Delivering ventricular extrastimuli a prolongation of the accessory pathway potential-atrium interval was seen demonstrating that decremental conduction was located at the atrial insertion of the pathway. The accessory pathway was successfully ablated using the potential as the target of radiofrequency delivery. These electrophysiological findings seem to support the hypothesis that a nodal-like structure may be responsible for this arrhythmia.

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Introduction

Permanent junctional reciprocating tachycardia (PJRT) is an uncommon form of arrhythmia. The arrhythmia is characterized by episodes of narrow QRS complex tachycardia alternating with a few beats of sinus rhythm[1-3]. The surface electrocardiogram (ECG) during tachycardia usually shows negative P waves in leads II-III-aVF and in V_4 up to V_6 with a RP > PR interval. Antegrade conduction occurs over the atrioventricular node while an accessory pathway with slow and decremental conduction properties constitutes the retrograde limb of the circuit[4-6]. The most common location of the accessory pathway is the postero-septal region, even if it may also be located in the left and right lateral annulus[7-12]. PJRT normally presents at birth or during childhood, but diagnosis may sometimes be delayed for several years. The tachycardia is usually refractory to drug therapy and its persistence may lead to a tachycardia-induced cardiomyopathy which is normally reversible and resolves following suppression of the arrhythmia[12-14]. At present, catheter ablation may provide definitive cure[6,8-12] but despite this possibility little is known about the anatomy, pathophysiology and site of decremental conduction of the accessory pathway.

The present case report demonstrates the feasibility of performing successful radiofrequency ablation under the guidance of a distinct accessory pathway potential. Besides, slow and decremental conduction was demonstrated to be located at the atrial insertion of the accessory pathway.

Case report

In December 1998 a 48-year-old woman presenting with PJRT was admitted to our Department for treatment. Patient history included well tolerated palpitations since childhood. The palpitations lasted from minutes to hours and their frequency increased with age. PJRT had been diagnosed in 1988 (Fig. 1). At that time antiarrhythmic prophylaxis using beta-blockers was ineffective.

Cardiac work-up, including echocardiography, revealed no apparent structural heart disease except for mild mitral regurgitation. Holter monitoring demonstrated incessant tachycardia with only brief periods of sinus rhythm.

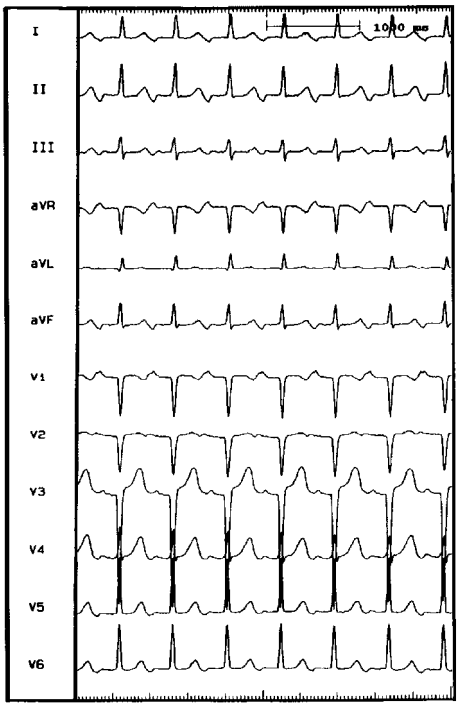

Figure 1. *Twelve-lead electrocardiogram of permanent junctional reciprocating tachycardia. The electrocardiogram shows the typical pattern of long RP tachycardia. Note the negative P wave in lead I possibly indicating a left sided accessory pathway.*

Electrophysiology study and ablation procedure. Having obtained written informed consent and discontinued beta-blockers for at least 5 half lives, the patient was submitted to electrophysiological evaluation. An octapolar steerable catheter (Cordis-Webster Inc., Baldwin Park, CA, USA) was positioned in the coronary sinus via the left subclavian venous approach and three quadripolar catheters (Bard Electrophysiology, Billerica, MA, USA) were positioned in the His bundle region, the right ventricle and the high right atrium, respectively. Bipolar digitized endocardial electrograms and surface ECG leads were simultaneously recorded (1 KHz sampling frequency, 30-500 Hz band pass filters), displayed on a multichannel recorder and stored on magneto-optical disks (Cardiolab, Prucka Engineering Inc., Houston, TX, USA).

Endocardial recordings during tachycardia demonstrated that the earliest retrograde atrial activation occurred in the posterior region of the mitral annulus. Ventricular extrastimuli delivered during His refractoriness in tachycardia preceded the next retrograde atrial electrogram which, in turn, maintained the same activation sequence, thus confirming the presence of an accessory pathway. Decremental retrograde conduction in the accessory pathway was demonstrated by the delivery of ventricular extrastimuli during tachycardia: the shorter the coupling interval, the longer the ventriculo-atrial interval.

Having acceded to the posterior region of the mitral annulus via the retrograde aortic approach, this site was mapped using an ablation catheter (Cordis-Webster Inc., Baldwin Park, CA, USA). A distinct potential between the ventricular and atrial electrograms during tachycardia was recorded at the site of the earliest retrograde atrial activation (Fig. 2). This potential disappeared when the ablation catheter was moved from the atrio-

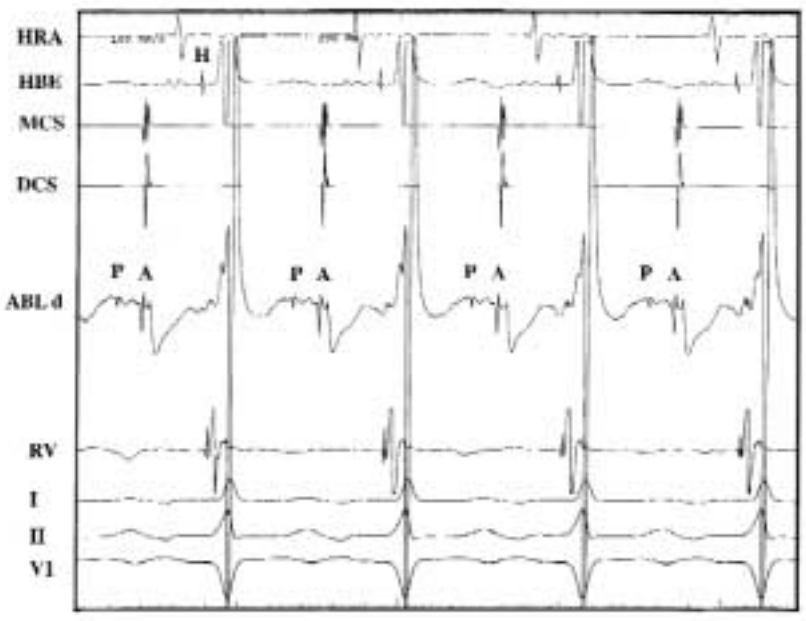

Figure 2. *Endocardial recordings during permanent junctional reciprocating tachycardia. The accessory pathway potential (P) between the ventricular and atrial (A) electrograms is evident on the distal ablation catheter (ABLd) recording. The tip of the ablation catheter was located at the posterior region of the mitral annulus inferior to the valve as demonstrated by the low A/V ratio. DCS = distal coronary sinus bipolar recording from the posterolateral mitral annulus; H = His bundle potential; HBE = His bundle bipolar recording; HRA = high right atrium bipolar recording; MCS = coronary sinus bipolar recording from the posterior mitral annulus; RV = right ventricular bipolar recording; I, II, V_1 = electrocardiographic leads.*

ventricular annulus towards the ventricle. Ventricular extrastimuli delivered during His refractoriness determined a prolongation of the potential-atrial electrogram interval (Fig. 3); following administration of adenosine (12 mg i.v.), the potential disappeared and tachycardia interrupted retrogradely (Fig. 4). Atrial extrastimuli and incremental atrial pacing proximal to the accessory pathway location were not associated with any preexcitation.

Radiofrequency energy was delivered, in a temperature guided mode (preset temperature of 70°C; ATAKR, Medtronic, EP Systems Inc., Minneapolis, MN, USA), at the site of recording of the above-mentioned potential. Within a few seconds tachycardia ceased (Fig. 5). At the end of radiofrequency delivery the accessory pathway potential disappeared from the ablation catheter recording. Post-ablation electrophysiological evaluation demonstrated ventriculo-atrial dissociation. No acute or late complications occurred. The patient was discharged and no therapy was prescribed. After 22 months of follow-up, the patient is free from tachycardia.

Discussion

Several previous studies[1-12] have already demonstrated that the substrate of PJRT is an accessory pathway with only retrograde, slow and decremental conduction properties. In order to explain the electrophysiological characteristics of the accessory pathway several hypotheses have been made. Some years ago, Coumel et al.[10] postulated the presence of longitudinal dissociation of the atrioventricular node or of a true "nodoventricular fiber" (Mahaim fiber) supported by the fact that the earliest site of retrograde conduction during tachycardia was within the septal area. Gallagher and Sealy[11], on the other hand, postulated that, due to a developmental defect of the normal atrioventricular node, an accessory nodal-like structure was present in the region of the posterior septum or within the posteromedial left atrium.

Only Critelli et al.[12] demonstrated the presence of a tortuous Kent bundle type accessory pathway in a pathological specimen of a patient suffering from PJRT. They hypothesized that the slow and decremental conduction properties were due to the tortuousity of the fiber as experimentally demonstrated by Spach[13].

The possibility of recording a discrete AP potential implies that conduction occurs through a well defined fiber located across the atrioventricular annulus. A possible accessory pathway potential at the site of successful ablation has already been described in more than 50% of cases in previous studies[7,9]. Its presence was only speculative because in both studies the potential was very close to the fragmented atrial activity and was not differentiated from it.

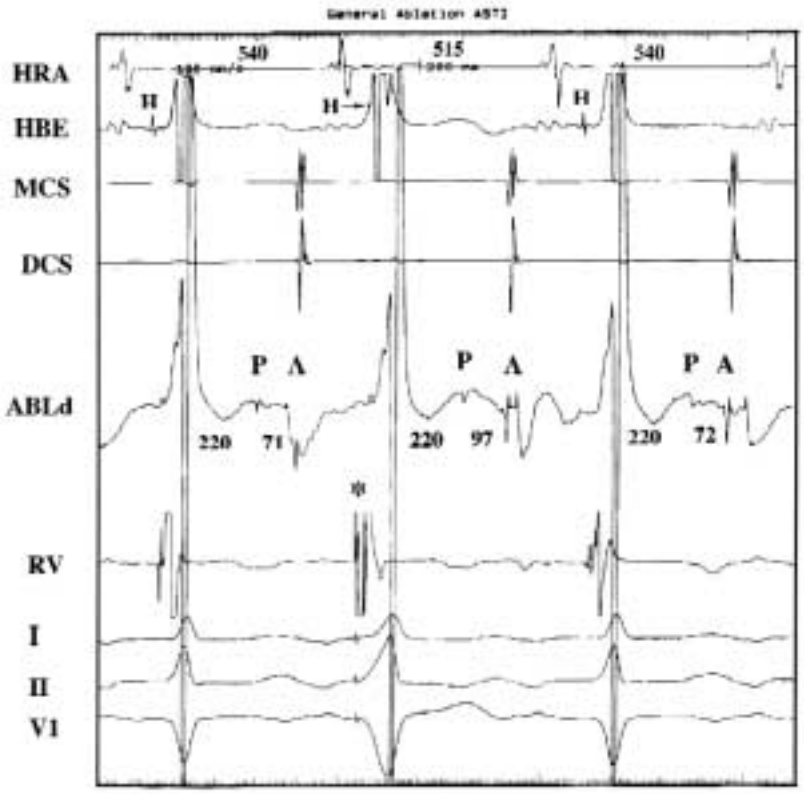

Figure 3. *Endocardial recordings during permanent junctional reciprocating tachycardia. An induced ventricular premature beat during His refractoriness determined a 25 ms advancement of the next atrial electrogram on HRA recording, confirming the presence of an accessory pathway. Note the prolongation in the accessory pathway potential (P)-atrial electrogram (A) interval from 71 to 97 ms showing that decremental conduction was present between the P and the atrial insertion of the accessory pathway. Abbreviations as in figure 2. * ventricular extrastimulus.*

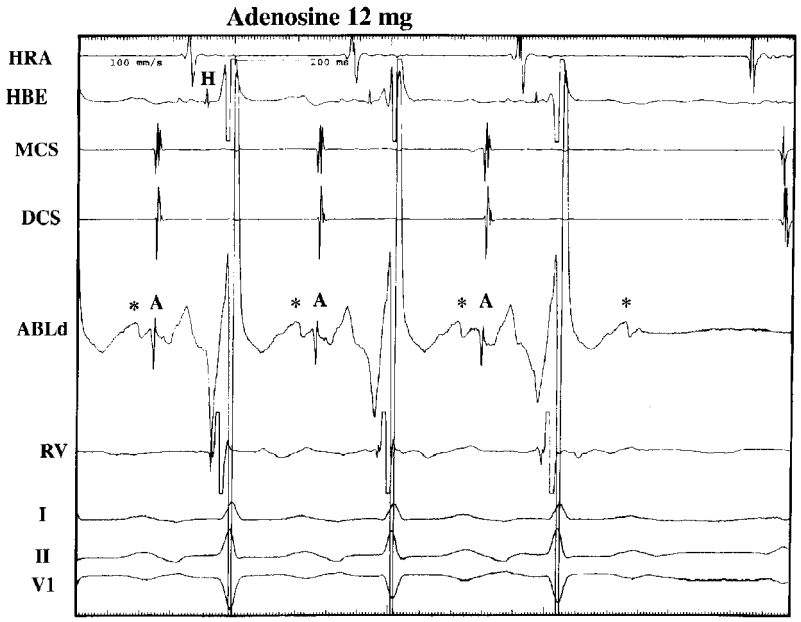

Figure 4. *Endocardial recordings following administration of a bolus of adenosine (12 mg) during permanent junctional reciprocating tachycardia. The tachycardia interrupted retrogradely. Abbreviations as in figure 2. * this sinusoidal electrogram appeared after adenosine administration probably representing a drug-induced modification of the previous sharp potential.*

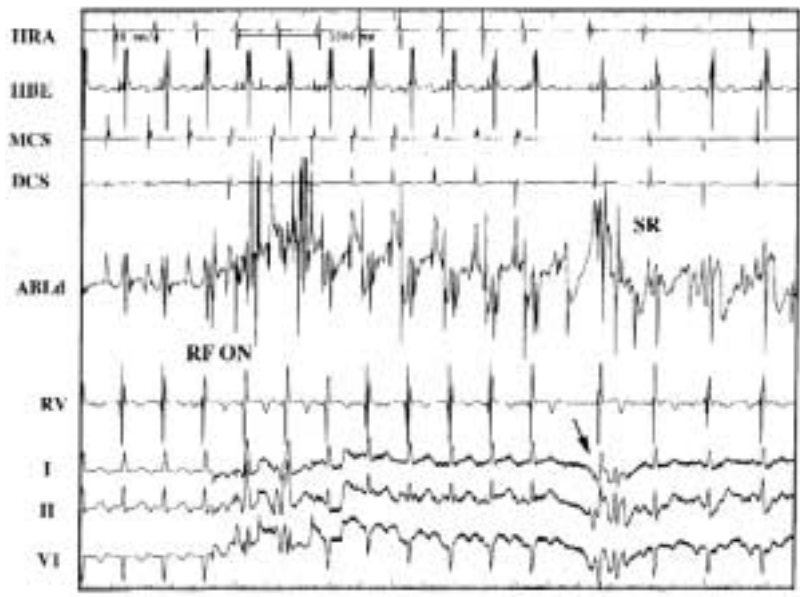

Figure 5. *Endocardial recordings during radiofrequency delivery. Retrograde interruption of permanent junctional reciprocating tachycardia* (arrow) *3.9 s following the onset of radiofrequency delivery (RF ON) with restoration of sinus rhythm (SR). Other abbreviations as in figure 2.*

In the present case report, of particular interest is the recording of a specific potential in the ventriculo-atrial interval, clearly distinguishable from the atrial and ventricular electrograms. This finding, associated with the fact that radiofrequency ablation at that site successfully resolved the arrhythmia, is highly suggestive of the presence of an accessory pathway potential. Besides, decremental conduction occurred at the atrial insertion of the accessory pathway as demonstrated by the prolongation of the accessory pathway potential-atrium interval when ventricular extrastimuli were delivered during His refractoriness. The slow and decremental retrograde conduction was also shown to be adenosine-sensitive. The electrophysiological characteristics emerging from our case seem to support the hypothesis that this "pathway" may be a nodal-like structure[11]. Furthermore, in a recent publication[14], the presence of an accessory atrioventricular node with properties of a typical accessory pathway has been demonstrated in a pathological specimen. In conclusion, we hypothesize that, in our case, a "nodal" component may have been present on the atrial side where decremental properties were identi-

fied and that a discrete bundle was present between the atrial and ventricular insertions as demonstrated by the possibility of recording a distinct potential in the ventriculo-atrial interval.

In conclusion, this report demonstrated the possibility of recording a distinct accessory pathway potential in a patient with PJRT. It also provided evidence that decremental conduction is located at the atrial end. Radiofrequency energy delivered at the site of accessory pathway potential recording successfully ablated the pathway. The electrophysiological characteristics of this "pathway" seem to support the hypothesis that it may represent a nodal-like structure.

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