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Case Report

Successful Catheter Ablation in an Infant With Multiple Accessory Pathways and Incessant Arrhythmia

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ABSTRACT

Wolff–Parkinson–White (WPW) syndrome is a common cause of supraventricular tachycardia encountered in childhood. We herein describe a 2-month-old male infant with paroxysmal supraventricular tachycardia that was refractory to multiple antiarrhythmic medications. The diagnosis of orthodromic reciprocating tachycardia over multiple accessory pathways was confirmed by meticulous mapping. One of the accessory pathways was located in the mid-septal region, and it acted as the retrograde limb in the arrhythmia circuit. The other accessory pathway was located in the right free-wall region, and it intermittently acted as the antegrade limb of the arrhythmia. Ablating the mid-septal accessory pathway eliminated the arrhythmia. ***(Iranian Heart Journal 2021; 22(2): 119-123)***

KEYWORDS: Supraventricular tachycardia, Multiple accessory pathways, Infant, Ablation

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CASE REPORT

A 2-month-old boy, weighing 5 kg, was admitted to our center with irritability and poor feeding. Physical examination and electrocardiography monitoring revealed an incessant tachyarrhythmia. The arrhythmia had started weeks before, and it was refractory to multiple antiarrhythmic medications, including propranolol, amiodarone, flecainide, sotalol, and propafenone and their different combinations.

After a thorough medicolegal consultation, the infant was transferred to the electrophysiology (EP) lab. The procedure was performed under general anesthesia and mechanical ventilation. During the incessant supraventricular tachycardia (SVT), we deployed 2 electrophysiology catheters: a 4-F Decapolar catheter from the left femoral vein to the right ventricle and a 5-F mapping/ablation catheter from the right femoral vein to the right side of the heart.

The arrhythmia had a fixed and short RP pattern with 2 different QRS morphologies and cycle lengths (Fig. 1). The tachyarrhythmia was briefly terminated with adenosine, but it rapidly recurred. During the temporary cessation, the delta wave was observed by morphology, in favor of a septal accessory pathway. After ventricular overdrive pacing during the arrhythmia, a V-A-V activation sequence was recorded. Premature ventricular stimuli were delivered during the tachycardia while the His bundle

was refractory, which indicated atrial manifest advancement. All the mentioned findings were in favor of atrioventricular reentrant tachycardia (AVRT). Moreover, the presence of 2 different tachycardia cycle lengths, namely QRS morphologies and AV intervals, suggested the presence of multiple accessory pathways. First, the retrograde limb of the arrhythmia was mapped; then, the earliest atrial activation was recorded in the right mid-septum. Low-energy (15 W) radiofrequency delivery terminated the arrhythmia and established normal sinus rhythm. After a few seconds, the delta wave was observed; nonetheless, the patient remained in sinus rhythm. Mapping showed the earliest ventricular activation signal at the same place (right mid-septal). Titrated radiofrequency application abolished the accessory pathway successfully without affecting atrioventricular nodal conduction.

An electrophysiological evaluation was done immediately after the ablation and subsequently 30 minutes later. Arrhythmia could not be inducted either with different pacing maneuvers or after isoproterenol infusion. The infant was discharged from the hospital in good health, in sinus rhythm, with a good ejection fraction, and without any anti-arrhythmic drugs 3 days after the procedure. Three years' follow-up revealed no recurrence, and the child was in good health in his last visit. He had normal sinus rhythm and a normal ventricular function. The presumed arrhythmia circuit is illustrated in Figure 1.

DISCUSSION

The last PACES/HRS expert consensus statement on the use of catheter ablation in children and patients with congenital heart disease divided children into larger (weight ≥15 kg) and smaller (weight <15 kg). [1] Catheter ablation is the therapy of choice for larger children with symptomatic WPW syndrome with normal heart anatomy or structural heart diseases. [1-4] Amongst infants and smaller children, drug therapy is the first line of therapy for controlling the arrhythmia; however, in refractory cases, catheter ablation remains the only possible treatment. [3] Orthodromic AVRT is the most common form of arrhythmia in patients who have an accessory pathway; nevertheless, other forms of tachyarrhythmia including antidromic AVRT, atrioventricular nodal reentrant tachycardia (AVNRT), and different types of atrial tachycardia could happen in these patients. [5] Tachycardia may also involve multiple accessory pathways, which may provide antegrade and/or retrograde conduction and may alternate antegradely or retrogradely. In some patients, the accessory pathway simply acts as a bystander and does not participate in the tachycardia mechanism. [6] Especially in small children, it is very important to confirm the exact mechanism of the arrhythmia before embarking on ablation. SVT in infancy is difficult to control and may require multiple medications and, occasionally, ablation. [7, 8] The incidence of multiple bypass tracts is reported to range between 5% and 18% in the radiofrequency ablation series. It is, therefore, essential to identify patients with more than 1 accessory pathway, bearing in mind that they represent a challenge to electrophysiologists. [9] Findings suggest that the diagnosis of multiple bypass tracts is based on the following criteria: 1) more than 1 P-wave morphology during orthodromic tachycardia; 2) mismatch between the location of antegrade and retrograde pathways; 3) atrial fibrillation showing different QRS configuration patterns; 4) spontaneous change from orthodromic tachycardia to antidromic and vice versa; 5) spontaneous change from 1 type of antidromic tachycardia to another; and 6) demonstration of different pathways during the administration of drugs. [9-11]

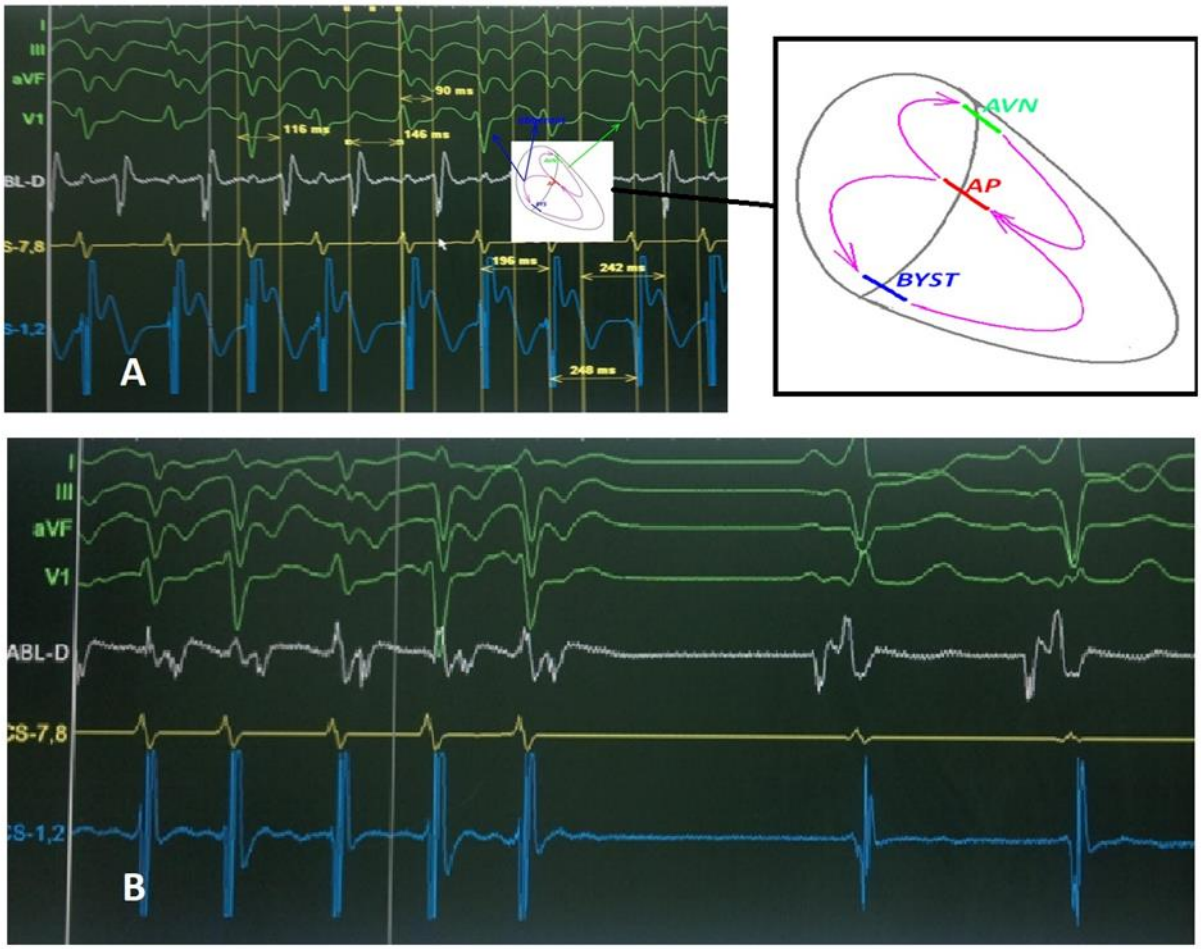

Figure 1: Intracardiac signals during electrophysiology study and ablation are depicted herein. A) The changing of the cycle length and the QRS width during arrhythmia is illustrated, with the assumed mechanism shown schematically. The retrograde conduction is over the dominant accessory pathway, and the antegrade conduction is intermittently over the atrioventricular node (AVN) (narrow complexes) and the bystander accessory pathway (wide complexes). B) The image illustrates the successful termination of the tachyarrhythmia after adenosine injection. Note the pre-excitation in the last 2 beats.

The definition of multiple bypass tracts is based on an approximation of the distance between accessory pathways during catheter-based mapping. Many accessory pathways may have broad atrial or ventricular insertions. A broad insertion may lead to the diagnosis of 2 or more accessory pathways. The possibility of an oblique course of the accessory pathway should be differentiated from the presence of 2 closely located accessory pathways when each pathway has unidirectional conduction in opposite directions (antegrade and retrograde). [10] In our case, the 2 accessory pathways acted as antegrade and retrograde limbs of the arrhythmia circuit; this pattern confirmed the diagnosis of multiple pathways. Although the ablation of multiple bypass tracts carries a high success rate, the rate of recurrence per patient is relatively high. The number of lesions required, the length of the procedure, and exposure to radiation are also increased. [8] Several case series have shown that catheter-based cryoablation can successfully be performed in children, particularly in those with AVNRT and mid-septal pathways. [12, 13]

One report demonstrated that this modality could be safely performed in children as light as 20 kg. [12] Nonetheless, the electrophysiologist is likely to face a serious challenge when using stiff cryoablation catheters for smaller children.

A comparison study of cryoablation between 4 mm cryoablation and radiofrequency ablation in pediatric AVNRT found similar short-term efficacy rates (95% vs 100%) but higher recurrence rates in the cryoablation group (8% vs 2%). [13, 14] We preferred 5-F radiofrequency catheters to large stiff 7-F cryoablation catheters. A 4-F Decapolar catheter was also used for ventricular signal recording and stimulation.

In our patient, the earliest ventricular activation signal during sinus rhythm (with the delta wave) was found in the right mid-septal region. The earliest atrial activation signal during the arrhythmia (with both QRS morphologies) was also recorded at the same location. After the ablation of that overt septal accessory pathway, no arrhythmia could be induced by different pacing maneuvers. During our 3 years' follow-up, the patient was asymptomatic and in normal sinus rhythm without pre-excitation.

CONCLUSIONS

AVRT over multiple accessory pathways is one of the mechanisms of incessant tachyarrhythmia. Although drug therapy is the first line for controlling arrhythmia in infants, catheter ablation is an effective tool for eliminating drug-refractory cases. Our study showed that the ablation of the culprit accessory pathway may be enough for controlling the arrhythmia in small high-risk patients.

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