

**Title:** Adenosine insensitive “pseudo antidromic” atrioventricular re-entry tachycardia:  
The Duodromic tachycardia

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**Abstract:**

Manifest AP on the electrocardiogram (ECG) predispose patients to atrioventricular reentry tachycardia, atrial fibrillation (AF), malignant arrhythmias and sudden cardiac death. [1,2] The authors report a case of a male patient admitted to the emergency room (ER) with a wide QRS complex tachycardia with no response to antiarrhythmic therapy with adenosine. The arrhythmia terminated with amiodarone perfusion and basal ECG showed ventricular pre-excitation. An electrophysiologic study (EPS) was performed diagnosing two different accessory pathways (AP) which were successfully ablated. However, 6 months later the ECG showed recurrence of the ventricular preexcitation. A new EPS was proposed with successful ablation of a third AP.

**Case presentation:**

A 45-years-old man with Charcot-Marie-Tooth disease and Wolf Parkinson White Syndrome (WPW) with recurrent palpitations was referred to our hospital for an ablation of AP. He was previously admitted to the ER due to persistent rapid palpitations and hemodynamically tolerated regular tachycardia with a cycle length of 377ms, wide QRS complexes with left bundle branch pattern and superior axis (figure 1A), assumed as an antidromic AVRT. In the emergency room I.V. propranolol (2mg) was first used, and a bolus of adenosine (12mg in the first attempt, and 18mg in the second attempt) without arrhythmia interruption. Later, the arrhythmia terminated under amiodarone perfusion. Basal ECG, in sinus rhythm, showed ventricular pre-excitation with a morphology suggestive of a right posterior AP (figure 1B). Transthoracic echocardiogram excluded structural heart disease. An EPS was performed to diagnose and ablate the AP.

Under local anesthesia, multipolar electrode catheters were inserted aiming to ablate a right AP. A 3D mapping system EnSite Precision™ (Abbott) was used. During ventricular stimulation, ventricular-atrial (VA) conduction was observed, with a shorter interval at the distal poles of the coronary sinus (CS) catheter, with eccentric and non-decremental conduction. Anterograde activation with pre-excitation through a right lateral pathway was observed (figure 2A). A FlexAbility™ irrigated ablation catheter was positioned at the tricuspid annulus, in the site where the shortest atrioventricular

(AV) interval was observed. Radiofrequency (RF) was applied (40W, 15ml irrigation and limited by maximum temperature of 42°C) with disappearance of the AP conduction in the first 5 seconds. At this time, transeptal puncture was decided to map the left chambers. Retrograde mapping during ventricular pacing showed a shorter VA interval, with continuous electric activity near the 2/1 dipole of CS catheter. RF was applied in this location, with abolition of conduction through this pathway. After a 20-minutes observation period, there was no evidence of recurrence of pre-excitation (Figure 2B) and VA dissociation during ventricular stimulation was documented (Figure 2C). Ablation of right lateral and left lateral pathways was considered successful (Figure 2D).

The patient was discharged on the next day, asymptomatic and with no evidence of pre-excitation in the ECG. At 3-months evaluation in an out-patient clinic visit there was pre-excitation on ECG. However, 6 months after ablation the ECG showed recurrence of the ventricular preexcitation. Despite being asymptomatic, a new EPS was proposed. The patient was in sinus rhythm with manifest pre-excitation with delta wave with superior axis, negative in aVR and positive in aVL, isoelectric in V1 and positive in V2, suggesting a posteroseptal AP location (figure 3A). Apical right ventricular stimulation showed decremental and concentric retrograde conduction, exclusively nodal. Incremental right atrial appendage stimulation obtained exacerbation of ventricular pre-excitation, with conduction through the AP until an anterograde refractory period of 320msec. We performed electroanatomic 3D mapping of AV conduction with the COLUMBUS Microport system (figure 3B). A continuous AV activity was documented at the CS ostium, with a negative monopolar morphology. RF ablation was applied through an irrigated FireMagic™ 3D ablation catheter (40W, 15ml irrigation and limited by maximum temperature of 40°C) and eliminated the conduction through the AP after 4 seconds (figure 3C). During a 20-minutes observation period, there was no recurrence of ventricular pre-excitation. The patient was asymptomatic, with a normal ECG, 6 months after the repeated procedure.

## **Discussion:**

Accessory pathways (AP) result from an abnormal embryological development during differentiation of the fibrous tissue that separates the atria and ventricles.

Patients with multiple AP, with a described prevalence of 3-15%, are even at higher risk of supraventricular tachycardias with the potential for extremely fast anterograde AP conduction during AF, that may result in ventricular fibrillation (VF). [2,3] Multiple AP are more prevalent in male gender and cardiomyopathies, especially Ebstein anomaly. These patients may have symptoms at younger ages, with right lateral AP in the basal ECG, and antidromic atrioventricular reentrant tachycardia (AVRT) or even VF [2]. The first-line therapy for symptomatic manifest AP is catheter ablation through application of RF or cryoenergy. Success rates depend on the location of the AP: 90% for right-sided pathways and up to 97% for left-sided pathways. [4] However, the literature describes 3% to 10% unsuccessful ablations, being the non-recognition of the presence of more than one AP the most common reason for failure. [1,4] In this patient, the mechanism explaining the lack of response to the repeated (and higher dosage) administration of adenosine was the fact that the pre-excited AVRT used a second AP as the retrograde limb of the circuit, a phenomenon rarely described, known as duodromic tachycardia.

The authors think this is the most probable explanation, since the nodal VA conduction after the first ablation procedure was latent. Unfortunately, the clinical tachycardia was not inducible during the procedure. If the tachycardia was inducible, a bolus of 30mg adenosine with the blocked the A-V node (His deflection would disappear), without terminating or altering the tachycardia, would be the final proof of the duodromic mechanism (one as the antegrade branch, the other as the retrograde branch). Also interesting is the fact that the third AP was not active during the procedure, even though it was most probably responsible for the clinical tachycardia, since the ECG during tachycardia suggested a right posterior AP. In this case, we considered that the third AP must have had an interruption of conduction during the first procedure due to repeated trauma in the CS ostium during catheter positioning. This is corroborated with the observed supraventricular ectopy that we point in figure 2A and the fact that there is no pre-excitation in the end of the first ablation procedure. Other reason for a late appearance of this AP near the CS ostium could be explained by dynamic conduction properties of AP which can change over time [5]. Although spontaneous loss of pre-excitation is well studied, the manifestation of a new AP is rare. In our patient, the identification of dual AP in the first EPS was

demonstrated by different sites of earliest atrial activation and successful ablation of both AP.

Multiple AP represent diagnostic and therapeutic challenges. Since they predispose to faster atrial and ventricular arrhythmias, its identification and ablation during EPS is essential and mandatory, but not always possible due to unexpected procedure limitations. Pre-excited AVRT using a second AP as the retrograde limb of the circuit is a rare mechanism that should be considered after no response of the tachycardia to adenosine administration.

#### **References:**

- 1- Helm R., Varkey S., Karnik A. Differential effective refractory period as a useful marker of multiple accessory pathways. *J of Arrhythmia*. 2019; 35:296–299.
- 2- Orczykowski M., Derejko P., Urbanek P., *et al.* Characteristic features of patients with multiple accessory pathways. *Acta Cardiologica* 2017; 72(4): 404-409
- 3- Zachariah P., Walsh E., Triedman J., *et al.* Multiple Accessory Pathways in the Young: The Impact of Structural Heart Disease. *Am Heart J*. 2013 165(1): 87–92
- 4- Joung B. Markers for Catheter Ablation of Atrioventricular Accessory Pathways. *Korean Circulation J*. 2017. <https://doi.org/10.4070/kcj.2017.0113>
- 5- Lee A., Lindemann J., Davison O., *et al.* Spontaneous transformation of a concealed to manifest posteroseptal accessory pathway requiring epicardial ablation. *J of Arrhythmia* 2018;34:312–314