



Case report

Long RP tachycardia: a diagnostic challenge. A case report

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ABSTRACT

Permanent junctional reciprocating tachycardia (PJRT), also known as Coumel tachycardia, is a rare form of supraventricular tachycardia predominant in children and classically associated with tachycardia-induced cardiomyopathy. Its occurrence in adults is uncommon, and recurrence after a previously failed conventional ablation is even less frequently reported. We report the case of a 33-year-old woman with palpitations since childhood. At 12 years of age, she underwent a conventional electrophysiological study with radiofrequency ablation. However, symptoms persisted, requiring multiple antiarrhythmic drugs and frequent emergency department visits with only partial control, prompting a redo procedure. On this occasion, three-dimensional electroanatomical mapping with the "open-window" technique was used. During the procedure, orthodromic reciprocating tachycardia (ORT) using a right posteroseptal occult accessory pathway with decremental retrograde conduction was diagnosed. Radiofrequency ablation of the accessory pathway was successful, with a favorable clinical outcome at follow-up. Coumel tachycardia is an unusual type of supraventricular tachycardia, even more so in adults. The diagnostic approach begins with the electrocardiogram and extends to invasive methods such as electroanatomical mapping, which enable precise characterization of the arrhythmic substrate.

Keywords: Tachycardia, Supraventricular; Cardiac Electrophysiologic Techniques; Radiofrequency Ablation; Reciprocal Tachycardia (Source: MeSH-NLM).

RESUMEN

Taquicardia de RP largo: un reto diagnóstico. Reporte de caso

La taquicardia recíproca permanente de la unión (PJRT), también conocida como taquicardia de Coumel, es una forma rara de taquicardia supraventricular predominante en niños y clásicamente asociada con cardiopatía inducida por arritmia. Su presentación en adultos es infrecuente, y la recurrencia luego de una ablación convencional previa fallida lo es aún más. Presentamos el caso de una mujer de 33 años con palpitaciones desde la infancia. A los 12 años se le realizó un estudio electrofisiológico convencional con ablación por radiofrecuencia. Sin embargo, los síntomas reaparecieron y, pese al tratamiento con múltiple medicación antiarrítmica, tuvo frecuentes ingresos a urgencias, por lo que se decidió realizar una nueva ablación. En esta ocasión, se utilizó la técnica de mapeo electroanatómico tridimensional Open window. Durante el procedimiento se diagnosticó una taquicardia con mecanismo reentrante y retorno ventrículo-auricular a través de una vía accesoria oculta posteroseptal derecha con conducción decremental. Se realizó la ablación de la vía accesoria con buen resultado clínico. La taquicardia de Coumel es un tipo inusual de taquicardia supraventricular, aún más en adultos. El abordaje diagnóstico inicia desde el electrocardiograma hasta el uso de métodos invasivos como el mapeo electroanatómico, que permite una caracterización precisa del sustrato arritmogénico.

Palabras clave: Taquicardia Supraventricular; Técnicas de Electrofisiología Cardíaca; Ablación Por Radiofrecuencia; Taquicardia Recíproca (Fuente: DeCS-BIREME).

Introduction

Reciprocating tachycardias pose a diagnostic challenge, especially those with a long RP interval, because they share clinical presentations and surface electrocardiographic (ECG) features with other supraventricular tachycardias (SVT), such as atrial tachycardia, atypical atrioventricular nodal reentrant tachycardia (AVNRT), and junctional tachycardia. Atypical AVNRT is classically reported as the most common long-RP SVT in young adult women.

Coumel tachycardia, or permanent junctional reciprocating tachycardia (PJRT), is a rare form of SVT mediated by an accessory pathway (AP) capable of decremental retrograde conduction, which produces an RP interval longer than the PR interval. One of its hallmarks is its incessant or permanent behavior ⁽¹⁾.

In children, PJRT accounts for approximately 1% of all SVTs in this age group and is classically associated with tachycardia-induced cardiomyopathy ⁽²⁾. In adults, the arrhythmia is much less frequent; its true prevalence is unknown, and case series are limited. Recurrences after a previously failed conventional electrophysiological study are sparsely reported in the literature.

In this report, we present an adult patient with a recurrence of Coumel tachycardia two decades after an initial unsuccessful conventional ablation, in whom three-dimensional (3D) electroanatomical mapping with the "open-window" technique was used to identify and ablate a right posteroseptal accessory pathway. The case is used to discuss three key points: 1. The differential diagnostic approach to long-RP tachycardia; 2. The role of high-density open-window mapping compared with conventional mapping in accessory pathway ablation; and 3. The peculiar features of Coumel tachycardia in adults.

Case report

A 33-year-old woman was referred to the electrophysiology service with recurrent palpitations requiring multiple emergency

department visits. She denied warm-up or cool-down phenomena, syncope, or angina. The physical examination showed blood pressure (BP) 99/61 mmHg, heart rate (HR) 87 beats per minute, and respiratory rate (RR) 22 breaths per minute, with no murmurs or signs of heart failure.

The patient reported palpitations since the age of four. At 12 years of age, she had undergone a conventional electrophysiological study with radiofrequency ablation. The targeted substrate was not specified in the records available to us. Symptoms persisted, requiring multiple antiarrhythmic drugs over the years with only partial control. During the six months preceding the current evaluation, her symptoms worsened, interfering with her daily life and prompting multiple emergency department admissions, after which a redo ablation procedure was offered and accepted. The patient had no other relevant comorbidities, and the transthoracic echocardiogram showed no structural heart disease.

The ECG taken during one episode in the emergency department showed a regular narrow-QRS tachycardia at 163 beats per minute, with negative waves preceding the QRS in leads DII, DIII, and aVF, and a positive deflection in V1, consistent with retrograde atrial activation. The RP interval was longer than the PR interval (**Figure 1**). Based on these findings, the differential diagnosis included atypical AVNRT, atrial tachycardia, junctional tachycardia, and orthodromic reciprocating tachycardia (ORT) via a slowly conducting accessory pathway. The sinus rhythm ECG showed no ventricular pre-excitation (**Figure 2**).

Given that the patient had a prior failed conventional electrophysiological study and ablation, with persistent incessant tachycardia despite multiple antiarrhythmic drugs, the procedure was planned with three-dimensional electroanatomical mapping and a high-density grid-type mapping catheter (16 electrodes). Intracardiac echocardiography (ICE) was used to facilitate real-time visualization of catheter-tissue contact during ablation, to monitor lesion formation in the vicinity of the coronary sinus ostium and the compact AV node, and to anticipate potential complications in an area of complex anatomy.

Under local anesthesia, a decapolar catheter was placed in the coronary sinus and a quadripolar catheter at the right ventricular apex. The patient developed her tachycardia upon entering the electrophysiology lab. The intracardiac electrograms

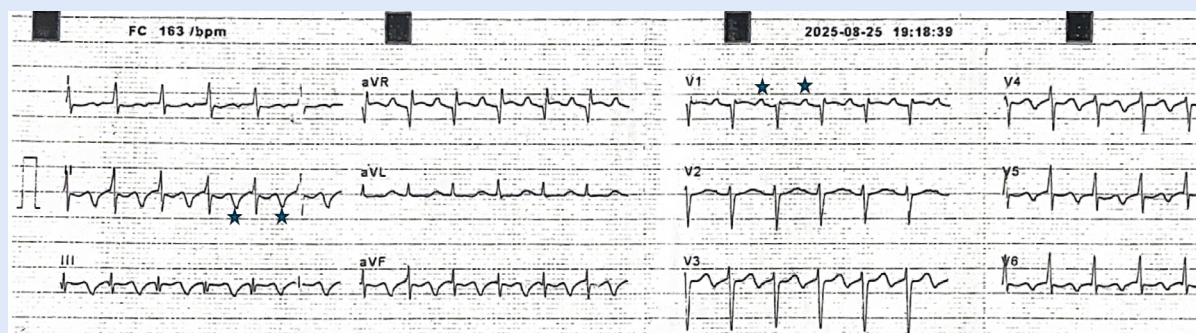


Figure 1. Narrow QRS complexes, with a regular RR interval at a frequency of 163/min. Before each complex, a negative wave can be observed in DII, DIII, and aVF, and a positive one in V1 (stars) that could correspond to the retrograde P wave. RP>PR is observed.

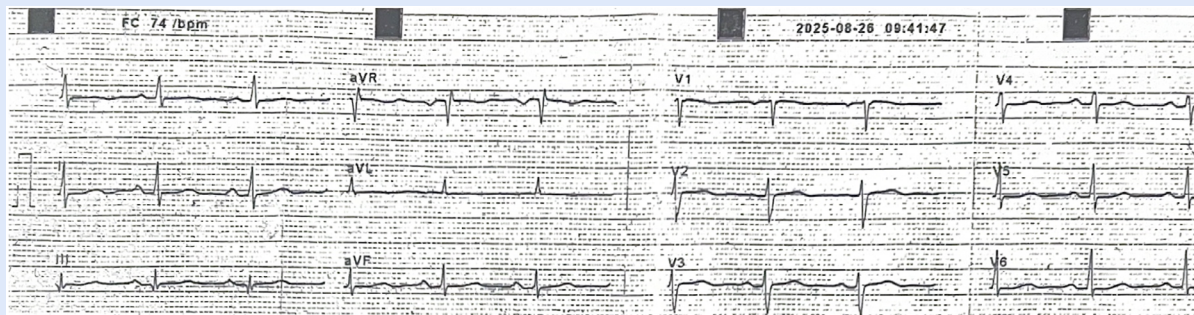


Figure 2. No pre-excitation signs are observed. The morphology of the p and T waves is the usual.

confirmed the presence of a P wave before the QRS, with a ventriculoatrial (VA) interval of 265 ms in the His channel and a concentric atrial activation pattern (**Figure 3**).

Stimulation maneuvers were performed during tachycardia. Ventricular overdrive pacing produced a V-A-V response upon cessation, ruling out atrial tachycardia. The stimulus-to-atrium minus tachycardia VA interval (SA-VA) was 41 ms, and the corrected post-pacing interval minus the tachycardia cycle length (PPI-TCL) was 78 ms (**Figure 4**). According to the criteria proposed by Michaud *et al.* (3), an SA-VA < 85 ms and a PPI-TCL < 115 ms reliably differentiate ORT via a septal accessory pathway from atypical AVNRT. In our patient, both criteria were met. Furthermore, ventricular pacing at progressively shorter cycle lengths during tachycardia demonstrated progressive lengthening of the VA interval, confirming the decremental nature of the retrograde limb, characteristic of the slowly conducting accessory pathway of Coumel tachycardia.

Activation and bipolar voltage maps were created using the high-density grid catheter. The “open-window” technique was applied. The window of interest was extended to include both atrial and ventricular signals at every acquired point, irrespective of the chamber of origin, and the extended early-meets-late (EEML) algorithm was used to visualize the

conduction “gap” corresponding to the atrial insertion site of the accessory pathway (4). Open-window mapping localized the earliest ventriculoatrial activation site at the right posteroseptal region, immediately adjacent to the ostium of the coronary sinus (**Figure 5**). With the integration of these findings, a definitive diagnosis of PJRT (Coumel tachycardia) due to a right posteroseptal occult accessory pathway with decremental retrograde conduction was established.

A 4-mm irrigated radiofrequency ablation catheter was advanced to the site of earliest atrial activation under fluoroscopic, electroanatomical, and ICE guidance (**Video 1**). Radiofrequency was delivered at 35 W. During the second application, abrupt tachycardia termination occurred within the first 20 seconds of energy delivery, with the disappearance of retrograde conduction. Following ablation, programmed ventricular stimulation demonstrated a complete absence of retrograde ventriculoatrial conduction through the accessory pathway (VA dissociation during ventricular pacing), confirming successful ablation. Atrial extrastimulation did not reinduce the tachycardia.

The patient remained in sinus rhythm during post-procedural observation. After 24 hours, she was discharged without complications and off antiarrhythmic drugs. At one-

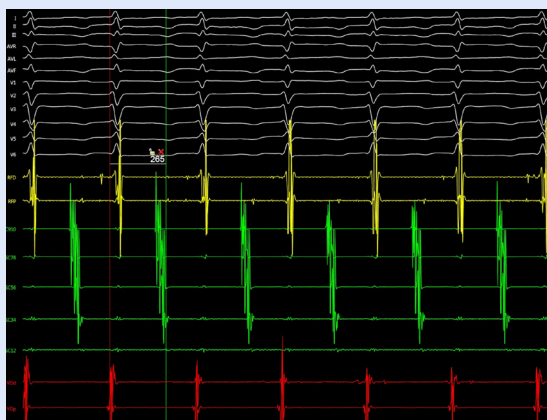


Figure 3. The VA is 265 ms in the His (RF) channel. The concentric atrial activation can be seen, as well as an RP>PR relation.

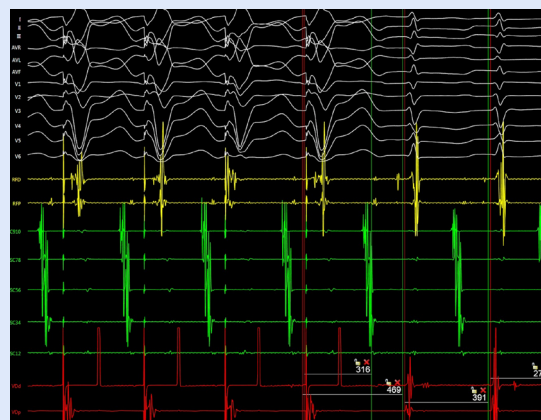


Figure 4. Mediations in the His (RF) channel. The SA-VA = 41 ms suggests a reentrant mechanism. The PPI-TCL = 78 ms is compatible with an accessory pathway instead of an AVNRT.

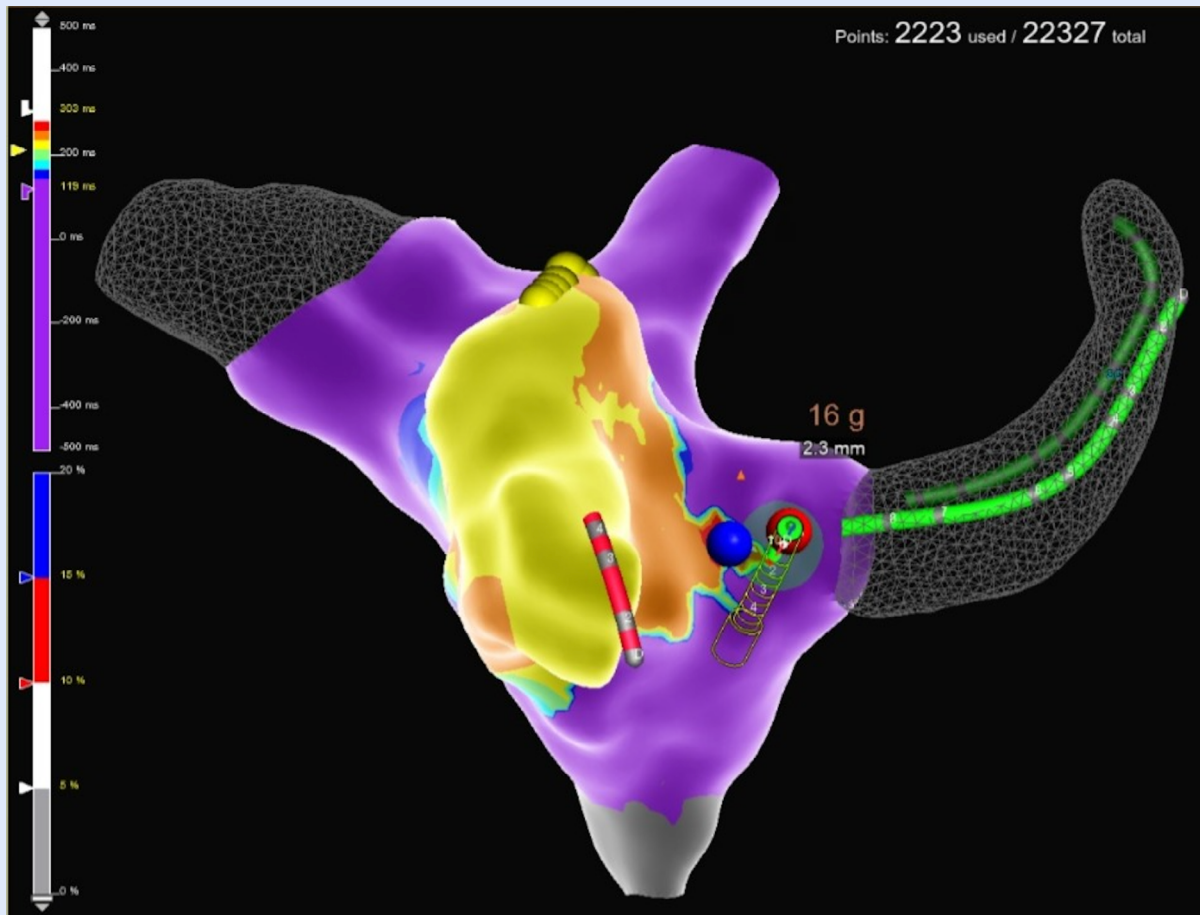


Figure 5. Ventriculoatrial activation site close to the ostium of the coronary sinus (blue dot).

month follow-up, she remained asymptomatic, with no further emergency department admissions and a full return to her usual activities (**Table 1**).

Discussion

This case illustrates three relevant aspects in the management of long-RP tachycardia in adults: 1. The differential diagnostic

approach to long-RP tachycardia; 2. The value of three-dimensional electroanatomical mapping with the open-window technique compared with a conventional point-by-point approach; and 3. The peculiar features of Coumel tachycardia in adults, particularly when it presents as a recurrence after a previously failed conventional ablation.

Differential diagnosis of long-RP tachycardia

A long RP interval is shared by atypical AVNRT, atrial tachycardia,

Table 1. Timeline of the case.

Date	Event	Description
20 years before	First ablation	The patient was 12 years old. First attempt at ablation. Conventional electrophysiological study
3 months before	Urgency service last attention	She is admitted to the emergency service due to the persistence of symptoms. SVT is documented.
1 month before	Outpatient appointment	The patient referred palpitations when she was a teenager. In the previous six months, she had been admitted multiple times to emergencies due to SVT. The echocardiogram showed no structural heart disease
Intervention day	Second ablation	The second ablation is conducted.
POD 1	Hospital discharge	After a 24-hour observation, the patient is discharged.
POD 30	Outpatient follow-up	She remains asymptomatic, and there have been no new emergency admissions.

POD: postoperative day. SVT: supraventricular tachycardia.

junctional tachycardia, and ORT via a slow-conducting accessory pathway. Distinguishing among these entities relies on a systematic electrophysiological evaluation. In our patient, the V-A-V response to ventricular overdrive pacing excluded atrial tachycardia. According to the criteria proposed by Michaud *et al.*, an SA-VA < 85 ms and a PPI-TCL < 115 ms differentiate ORT via a septal accessory pathway from atypical AVNRT, with both values clearly fulfilled in our patient (SA-VA 41 ms; PPI-TCL 78 ms)⁽³⁾. The demonstration of decremental retrograde conduction during incremental ventricular pacing, characteristic of the slowly conducting accessory pathway of Coumel tachycardia, was an essential additional finding that confirmed the diagnosis. Other classical maneuvers that may be useful in selected cases include para-Hisian pacing and entrainment from different ventricular sites. These conventional electrophysiological maneuvers remain indispensable and complementary to advanced mapping technologies.

Three-dimensional electroanatomical mapping and the open-window technique

Open-window mapping is a relatively recent extension of conventional activation mapping. By widening the window of interest to encompass both atrial and ventricular electrograms, and by applying the extended early-meets-late (EEML) algorithm, open-window mapping enables simultaneous visualization of the atrial insertion site, the ventricular insertion site, and the “gap” between them, which corresponds to the accessory pathway⁽⁴⁾. In a recent comparative study, high-density open-window mapping was associated with shorter total mapping time and shorter fluoroscopy time compared to conventional high-density mapping, with no differences in long-term recurrence rates⁽⁵⁾. Radiofrequency time is highly dependent on the substrate, on operator preference, and on the ablation endpoints adopted by each center and was therefore not consistently reduced across studies.

In our patient, several features justified the choice of a high-density grid-type catheter combined with the open-window technique. First, the procedure was a redo intervention after an unsuccessful conventional electrophysiological study performed 20 years earlier, which may have led to anatomical and electrical remodeling of the right posteroseptal region. Second, the tachycardia was incessant, which precluded prolonged manipulation in sinus rhythm and made high-density mapping in a single tachycardia run particularly attractive. Third, the slow conducting and decremental nature of the accessory pathway is known to complicate localization with conventional point-by-point activation mapping. The integration of these technologies allowed precise identification and successful ablation of the accessory pathway. Intracardiac echocardiography contributed beyond fluoroscopy reduction by enabling real-time confirmation of catheter–tissue contact during ablation in the vicinity of the AV node and the coronary sinus ostium, both critical structures in this anatomical region.

Coumel tachycardia in adults

In the largest case series of adults with PJRT, Meiltz *et al.* described 49 patients with a mean age of 43 years; the accessory

pathway was located in the right posteroseptal region in 76% of cases, with tachycardia-induced cardiomyopathy present in 16%⁽⁶⁾. Atypical locations have also been reported, including the mid-septal region⁽⁷⁾ and multiple septal accessory pathways⁽⁸⁾. Radiofrequency catheter ablation is highly effective in this population, with long-term success rates close to 100% in experienced centers⁽⁶⁾.

Our patient illustrates the typical phenotype of adult Coumel tachycardia: right posteroseptal accessory pathway, refractoriness to several antiarrhythmic drugs, a longer cycle length than that classically reported in children, and the absence of overt arrhythmia-induced cardiomyopathy. The relatively low frequency of cardiomyopathy in adults has been attributed to longer tachycardia cycle lengths, alternation between incessant and paroxysmal forms, and the rate-limiting effect of chronic antiarrhythmic therapy⁽⁶⁾.

A unique aspect of this case is its presentation as a recurrence two decades after a conventional electrophysiological study with attempted ablation. Whether the initial procedure targeted an incompletely characterized substrate or whether residual or recovered accessory pathway tissue is responsible cannot be determined from the available records. Regardless, the case underscores the diagnostic and procedural value of contemporary high-density mapping in patients for whom an initial conventional approach has failed. In the present procedure, bipolar mapping with the open window/EEML algorithm was used; omnipolar mapping technology was not applied in this case.

Among the limitations, this is a single case, and the findings must be interpreted accordingly. Detailed information about the initial electrophysiological study performed 20 years earlier was not available. Evidence supporting the use of open-window mapping in PJRT is still limited and largely based on case reports and small cohorts. Larger prospective studies will be required to define its role, particularly in adult patients and in redo procedures.

In conclusion, Coumel tachycardia should be considered in the differential diagnosis of adults presenting with long-RP tachycardia, especially when symptoms persist despite antiarrhythmic therapy. Classical electrophysiological maneuvers (V-A-V response after ventricular overdrive pacing, SA-VA, PPI-TCL, and demonstration of decremental retrograde conduction) remain essential for diagnosis. Three-dimensional electroanatomical open-window mapping with a high-density catheter is a useful tool that enables accurate localization of the accessory pathway and is particularly valuable in challenging scenarios such as incessant tachycardia or redo procedures, while reducing fluoroscopy and mapping time.

Ethical Considerations

Written informed consent was obtained from the patient. In addition, the report was approved by the institutional ethics committee.

Author's Contribution

JM: conceptualization, investigation, writing – original draft. **OA:** investigation, data curation, visualization, writing – original draft. **LG:**

investigation, data curation, visualization. **EG:** conceptualization, methodology, supervision, validation, writing – review & editing.

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