

# A High-Risk Substrate in a Small Heart: Ablation of a Concealed Para-Hisian Accessory Pathway in a 3-Year-Old—A Case Report

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## Case Report

**Keywords:** Catheter ablation, para-Hisian accessory pathways, Activation mapping

**Posted Date:** October 18th, 2026

**DOI:** <https://doi.org/10.21203/rs.3.rs-10932810/v1>

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**Additional Declarations:** No competing interests reported.

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# Abstract

**Background:** Catheter ablation of para-Hisian accessory pathways (PHAP) in children is technically demanding and carries a substantial risk of atrioventricular (AV) block. This risk is magnified in very young patients, in whom small cardiac dimensions place the AV node and His bundle in close anatomical proximity to the ablation target. Concealed PHAP cannot be localized by pre-excitation mapping, further increasing procedural difficulty. We report a 3-year-old girl with a concealed para-Hisian accessory pathway, representing two high-risk features: very young age and an ablation target immediately adjacent to the His bundle.

**Case summary:** A 3-year-old girl presented with recurrent paroxysmal tachycardia. Electrophysiological study confirmed orthodromic atrioventricular reentrant tachycardia mediated by a concealed para-Hisian accessory pathway. Activation mapping during tachycardia identified the earliest retrograde atrial activation adjacent to the His bundle at the 12 o'clock position of the tricuspid annulus. Radiofrequency energy was delivered in temperature-controlled mode at 25 W with a maximal target temperature of 45°C; tachycardia terminated within 3 seconds, followed by 60 seconds of consolidation ablation at identical parameters. No accelerated junctional rhythm or AV conduction deterioration was observed during energy delivery. Post-ablation, ventriculoatrial dissociation was documented, and no permanent AV conduction disturbance occurred. The patient remained free of arrhythmia-related symptoms at 2-week and 1-month follow-up.

**Conclusions:** This case demonstrates that radiofrequency catheter ablation can be performed safely and effectively in selected very young children with concealed septal accessory pathways. Success depends on meticulous activation mapping, stable catheter-tissue contact, and individualized low-power, temperature-titrated energy delivery. Additional multicenter experience is required to validate long-term safety and efficacy in this population.

## Case Report

Catheter ablation of tachyarrhythmias in toddlers presents unique procedural challenges because of the small cardiac chamber size, limited intracardiac operating space, and increased risk of injury to the cardiac conduction system. Published series reporting ablation of anteroseptal and midseptal accessory pathways in children demonstrate acute success rates of approximately 87%–89.1%, recurrence rates of 13%–18%, and AV block rates ranging from 1.2% to 31% [1,2]. Given this substantial complication risk, cryoablation is favored at many pediatric centers for septal substrates to reduce the likelihood of permanent AV block. However, cryoablation has well-recognized drawbacks, including lower spatial mapping resolution and higher long-term recurrence rates [3-5]. We report a 3-year-old girl with a concealed para-Hisian accessory pathway who underwent successful radiofrequency ablation.

# Main Text

A 3-year-old girl was referred for evaluation of recurrent episodes of paroxysmal palpitations. Given her young age, she was unable to describe her symptoms verbally. Her parents reported that during each tachycardia episode, she became irritable and cried inconsolably. A surface 12-lead electrocardiogram recorded during an event demonstrated narrow-complex supraventricular tachycardia. The patient was admitted for electrophysiological study with intent for catheter ablation.

## Investigations

The entire procedure was performed under general anesthesia to ensure immobility and adequate airway protection. Baseline rhythm was sinus. Given the small cardiac chamber dimensions in this toddler, a minimal catheter setup was adopted: a decapolar coronary sinus (CS) catheter and a quadripolar catheter positioned at the right ventricular apex (Figure 1).

Programmed ventricular stimulation using S1S1 and S1S2 protocols demonstrated persistent 1:1 ventriculoatrial (VA) conduction with a fixed VA interval up to the ventricular effective refractory period. No decremental retrograde conduction or AH jump was observed. Sustained narrow-complex tachycardia with a tachycardia cycle length (TCL) of 305 ms was reproducibly induced. The earliest retrograde atrial activation was recorded at the distal coronary sinus (CS 9-10).

Ventricular overdrive pacing (VOP) was performed during tachycardia at a cycle length of 280 ms. A V-A-V response was observed upon cessation of pacing, effectively excluding atrial tachycardia. The post-pacing interval minus tachycardia cycle length (PPI – TCL) was <115 ms, supporting the diagnosis of accessory-pathway-mediated tachycardia. Furthermore, ventricular extrastimuli delivered during the His-refractory period altered the subsequent atrial activation sequence, confirming a separate retrograde conduction pathway distinct from the AV node (Figure 2).

Additional electrophysiological assessment was completed using programmed atrial stimulation from the coronary sinus catheter. A reproducible S(A)-V-A' phenomenon was identified, consistent with retrograde conduction of ventricular activation back to the atrium via an accessory pathway (Figure 3).

A final diagnosis of orthodromic atrioventricular reentrant tachycardia mediated by a concealed accessory pathway was established, and activation mapping was initiated.

## Management

Retrograde atrial activation mapping during sustained tachycardia was performed using the CARTO 3 electroanatomic mapping system. The earliest retrograde atrial activation was localized immediately adjacent to the His bundle at the 12 o'clock position along the tricuspid annulus (Figure 4). Given the close proximity to the His bundle and limited intracardiac working space in this small heart, a B-curve Thermocool irrigated-tip ablation catheter was selected.

Radiofrequency energy was delivered from the atrial aspect of the tricuspid annulus in temperature-controlled mode, with power limited to 25 W and a maximal target temperature of 45°C. A conservative target temperature was deliberately chosen to minimize the risk of thermal injury to the adjacent AV node and His bundle, while still permitting adequate lesion formation given stable catheter contact and short lesion duration. Tachycardia terminated abruptly within 3 seconds of energy onset. No accelerated junctional rhythm or AV conduction delay was observed during ablation. Consolidation ablation lasting 60 seconds was delivered at identical settings after tachycardia termination, with continuous monitoring of His potentials and AV conduction (Figure 5).

After ablation, programmed ventricular stimulation demonstrated ventriculoatrial dissociation, confirming complete elimination of accessory pathway conduction (Figure 6). Subsequent programmed stimulation from the right ventricle and coronary sinus failed to induce any tachyarrhythmia.

### **Outcome and Follow-Up**

The patient had an uneventful post-procedural hospital course. Follow-up assessments were performed at 2 weeks and 1 month after ablation. At both time points, the patient remained free of palpitations or other arrhythmia-related clinical symptoms.

## **Discussion**

This case involved a 3-year-old girl with a concealed para-Hisian accessory pathway, with the ablation target adjacent to the His bundle, representing a high-risk scenario. We provided complete electrophysiological diagnosis, CARTO-3 mapping, low-power radiofrequency parameters, and post-ablation ventriculoatrial dissociation evidence, with no resulting AV conduction injury. This suggests that, when mapping is definitive and catheter contact is stable, radiofrequency ablation can be used in such young high-risk patients.

Published data report acute success rates of approximately 87%–89.1%, recurrence rates of 13%–18%, and AV block rates of 1.2%–31% for septal accessory pathway ablation in children [1,2], and para-Hisian pathways carry an even higher risk. Although cryoablation may reduce the risk of permanent AV block, it has lower mapping resolution and higher long-term recurrence rates [3–5]. In this case, radiofrequency ablation was selected because the earliest retrograde activation was clearly identified and catheter contact was stable.

The keys to success included precise retrograde atrial activation mapping, stable catheter contact at the target site, low-power (25 W) ablation, and a 60-second consolidation ablation after tachycardia termination, with continuous monitoring of His potentials and AV conduction. Post-ablation ventriculoatrial dissociation and non-inducibility of tachycardia confirmed complete elimination of the pathway, with no AV conduction injury.

The limitations of this case are that it is a single-case report with short-term follow-up. In the future, we will continue long-term follow-up of this patient to assess long-term recurrence and late effects on AV conduction. Nevertheless, this case suggests that, in experienced centers and in strictly selected young patients, low-power radiofrequency ablation may serve as an alternative to cryoablation, provided that precise mapping, stable contact, and close monitoring are ensured.

## **Conclusion**

This case demonstrates that radiofrequency catheter ablation can be performed safely and effectively in selected very young children with concealed septal accessory pathways. Success depends on meticulous activation mapping, stable catheter-tissue contact, and individualized low-power, temperature-titrated energy delivery. Acute procedural success was achieved without AV conduction injury, and the patient remained symptom-free at 2-week and 1-month follow-up. Nevertheless, this report describes a single case with short-term follow-up. Additional multicenter clinical experience is required to validate the long-term safety and efficacy of this approach in this patient population.

## **Declarations**

### **Ethics approval and consent to participate**

This is a retrospective case report based on routine clinical electrophysiological examination and CARTO-3 mapping data, without additional research-related interventions. Ethics approval was waived by the Ethics Committee of The First Affiliated Hospital of Xinjiang Medical University. Written informed consent was obtained from the patient in accordance with the Declaration of Helsinki.

### **Consent for publication**

Written informed consent was obtained from the patient's legal guardians for publication of all personal and clinical details, as well as identifying electrophysiological recordings and mapping images included in this case report. A copy of the consent form is available for review by the journal's editor upon request.

### **Availability of data and materials**

All data generated and analysed during this case report are included within the article.

### **Competing interests**

The authors declare that they have no competing interests.

### **Funding**

No funding was received for this study.

### **Clinical trial number**

not applicable

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## Figures



**Figure 1**

Baseline surface ECG and intracardiac electrograms recorded after catheter placement (paper speed 100 mm/s).



**Figure 2**

Ventricular overdrive pacing (VOP) performed during tachycardia at cycle length 280 ms. Following pacing cessation, a V-A-V response is demonstrated, excluding atrial tachycardia. PPI-TCL < 115 ms supports accessory-pathway-mediated tachycardia.



**Figure 3**

Reproducible S(A)-V-A' phenomenon during antegrade S<sub>1</sub>S<sub>2</sub> programmed stimulation delivered from the coronary sinus catheter.

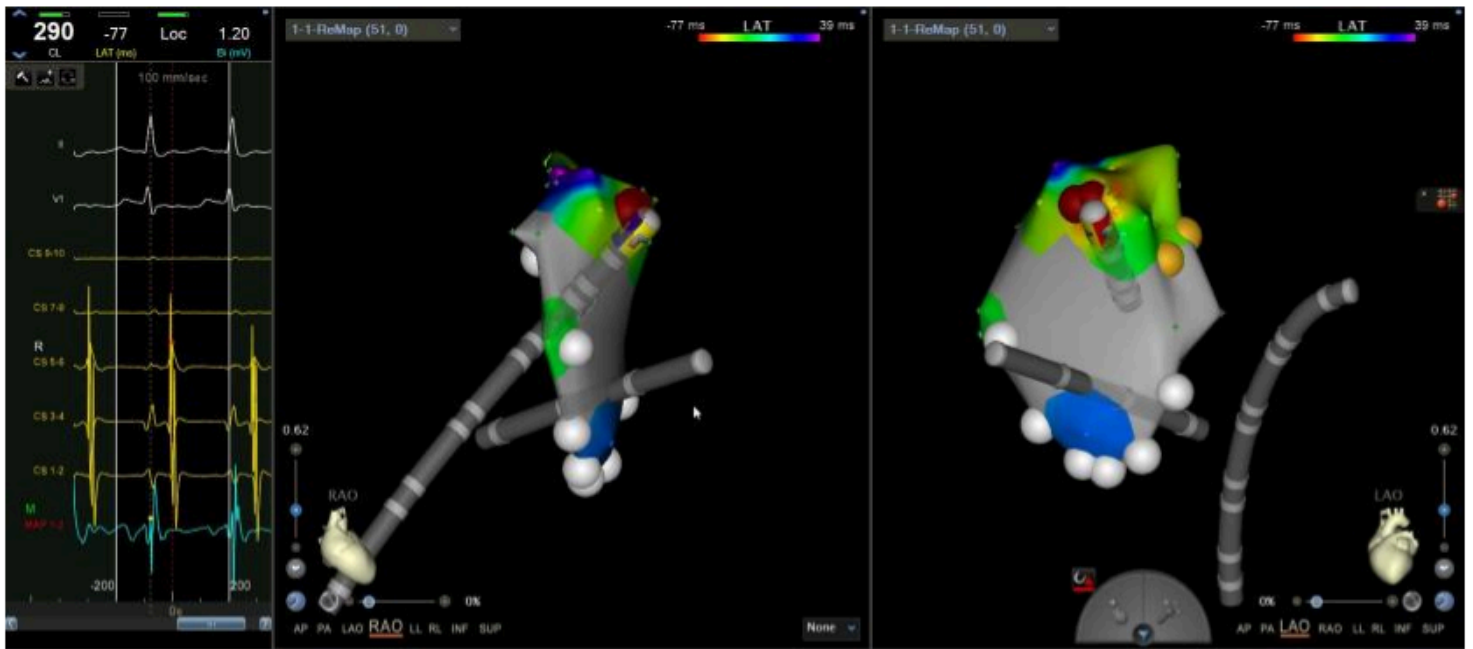


Figure 4

CARTO-3 electroanatomic activation map obtained during tachycardia. The earliest retrograde atrial activation (red region) is localized to the 12-o'clock position of the tricuspid annulus, immediately adjacent to the His-bundle region. RAO and LAO projections are displayed.

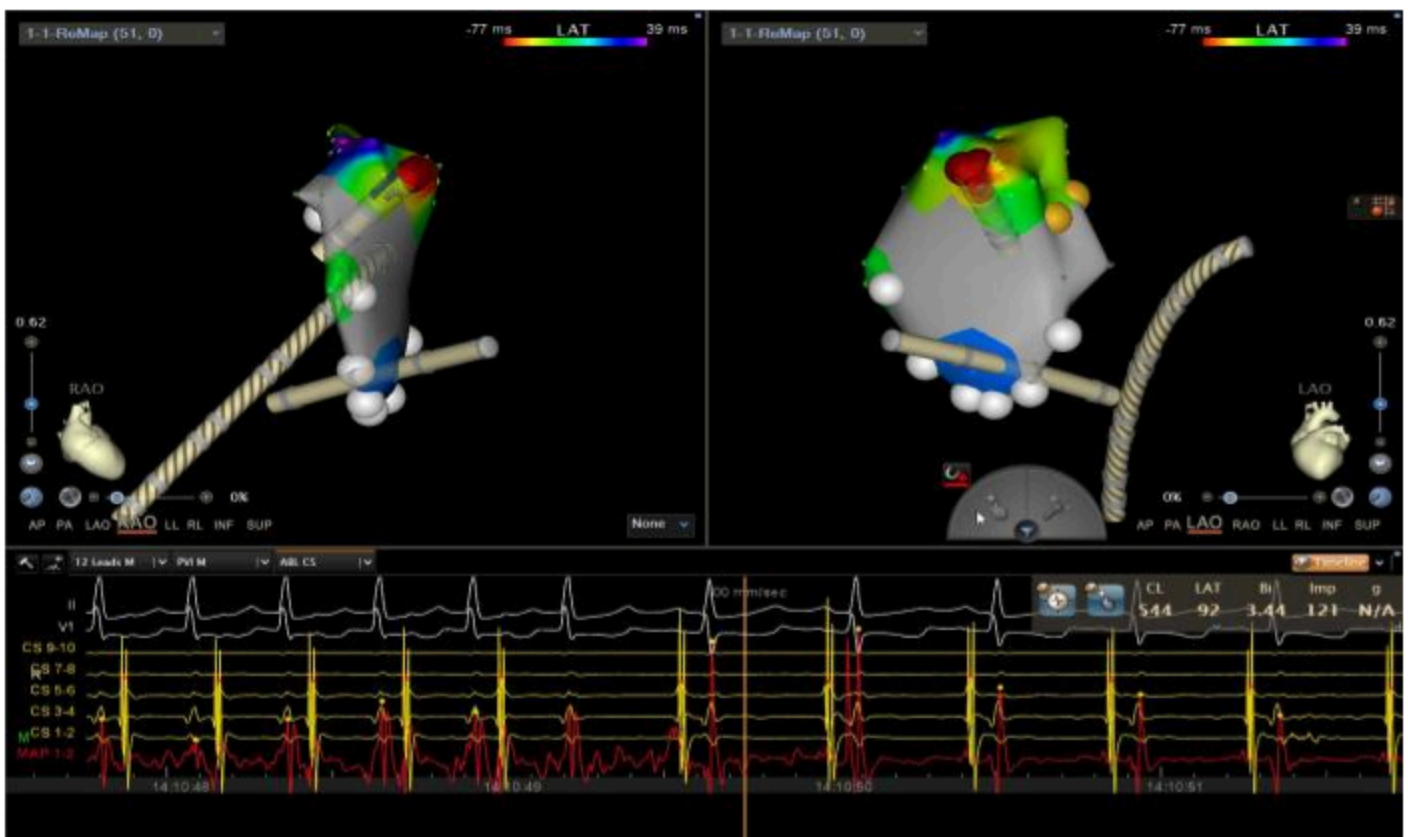


**Figure 5**

CARTO-3 map and intracardiac tracings demonstrating abrupt tachycardia termination within 3 seconds after initiation of radiofrequency energy delivery at the target site

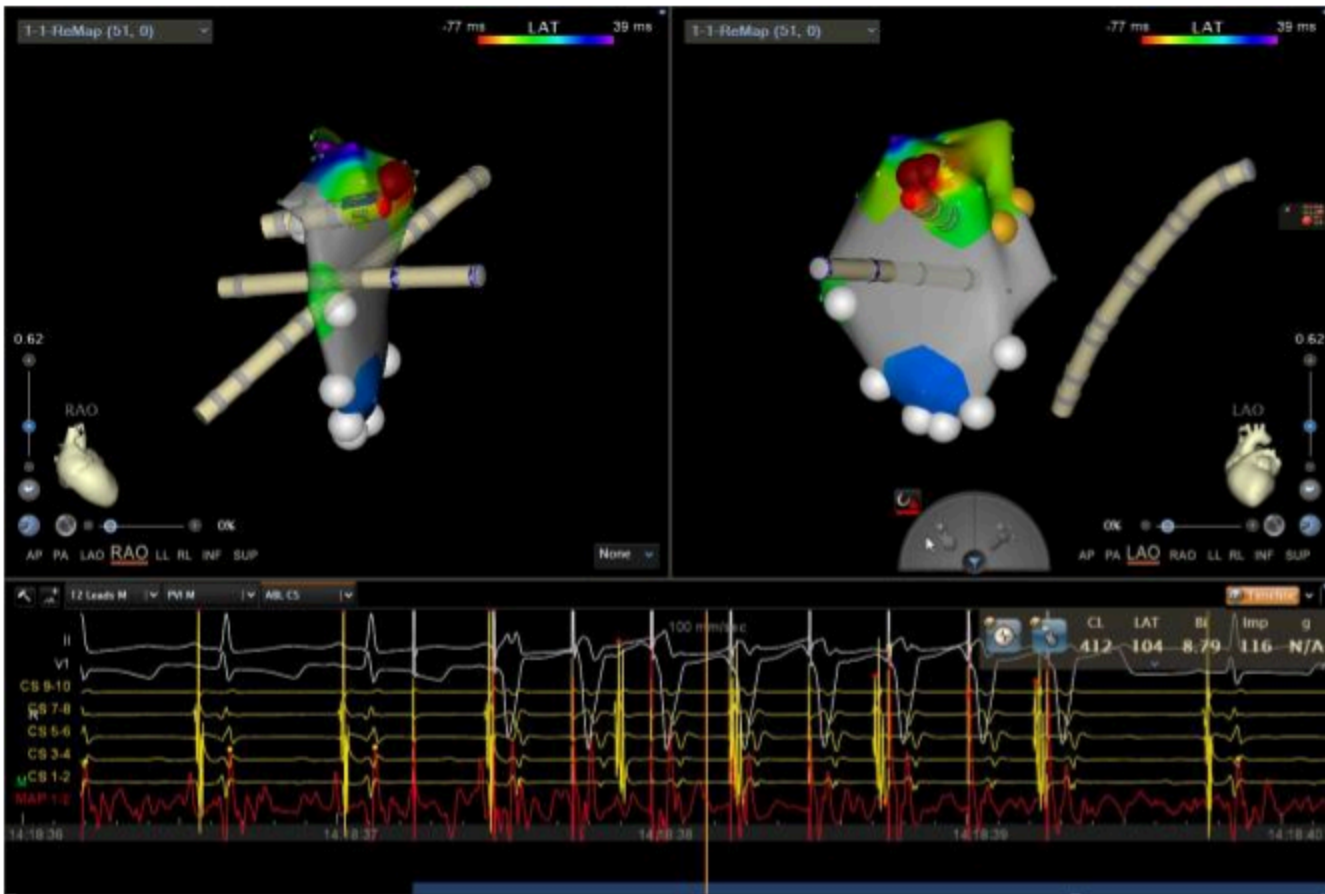


**Figure 6**

Post-ablation ventricular programmed stimulation demonstrating complete ventriculoatrial dissociation. Absence of VA conduction confirms successful elimination of the concealed accessory pathway.