

## Successful Ablation of an Automatic Rhythm Originating from His Bundle

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Automatic junctional tachycardias are rare supraventricular tachyarrhythmias observed mainly in infants and children. This arrhythmia has a high mortality rate. We report the case of a 22-month-old infant in which the electrophysiological study disclosed an incessant junctional tachycardia originating from an automatic focus located in the His bundle region. Radiofrequency pulse delivery to the His bundle with controlled progressive heating of this region resulted in a definitive ablation of the ectopic focus without complications.

**Key words:** *Catheter ablation. Tachycardia. Pediatrics. Heart block.*

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### **Ablación con éxito de un ritmo automático del haz de His**

Las taquicardias automáticas de la unión son una rara forma de taquiarritmia supraventricular, con incidencia sobre todo en la edad pediátrica y acompañadas de un mal pronóstico en su evolución espontánea. Presentamos el caso de un paciente de 22 meses de edad con una taquicardia incesante de la unión auriculoventricular con origen en un foco automático localizado en el haz de His o inmediato al mismo. Las aplicaciones de radiofrecuencia con incremento escalonado de temperatura en la misma región del haz de His consiguieron eliminar este automatismo sin complicaciones.

**Palabras clave:** *Ablación con catéter. Taquicardia. Bloqueo cardíaco. Pediatría.*

## INTRODUCTION

Automatic tachycardia from the atrioventricular (AV) junction is a rare form of narrow QRS arrhythmia with AV dissociation that has primarily been described in children.<sup>1-6</sup> Several authors have confirmed its natural malignant course and high mortality rate.<sup>2-5</sup> In general, these supraventricular tachycardias respond badly to pharmacological treatment. Recently, selective radiofrequency ablation of the ectopic focus has had a reasonably good success rate, although development of a complete AV block is a potential complication.<sup>7,8</sup> We present the case of a 22-month-old patient with incessant tachyarrhythmia in whom ablation of the para-Hisian ectopic focus was successfully performed.

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## CLINICAL CASE

22-month-old male child who, coincident with an upper respiratory febrile process, was observed to have notable cardiac arrhythmic on auscultation with the absence of a clinical picture compatible with hemodynamic decompensation, and he was admitted to the hospital. Chest X-ray and echocardiogram were normal. There was no personal or familial history of disease. ECG revealed tachyarrhythmia with an average frequency of 165 beats/minute, made up of narrow irregular QRS complexes with P-waves of sinus origin dissociated from ventricular activity (Figure 1).

An electrophysiological study was performed under local anesthesia, introducing tetrapolar catheters via the right and left femoral vein pathways, one for location in the His bundle (Josephson 4 F) and the other for cartography and ablation (Marinr 5 F, SCXL; 4 mm distal electrode) with radiofrequency via an Atakr source (Medtronic-CardioRhythm) with automatic temperature control. At the beginning of the study a clear reduction in ectopic activity frequency was observed that was attributed to the effects of the general

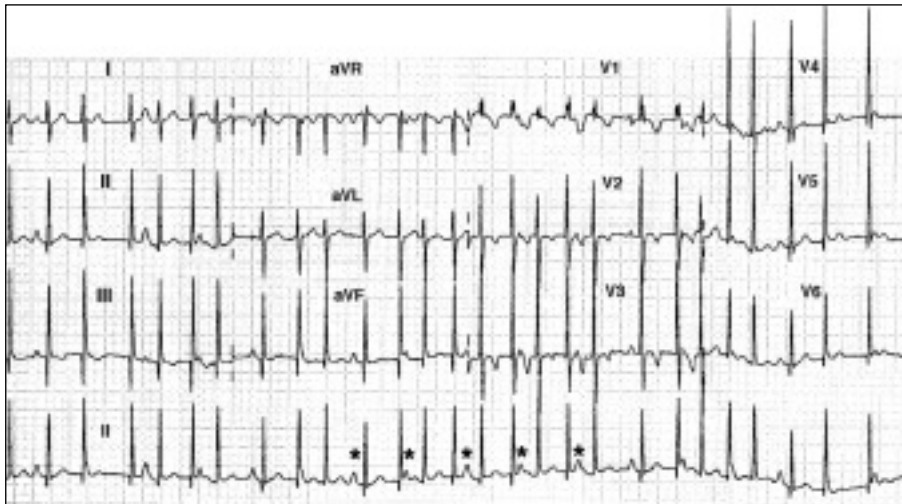


Fig. 1. 12-lead ECG (25 mm/s, 1 cm/mV) and continuous recording from lead II that shows the patient's tachycardia. The irregularity of the junction ectopy with narrow QRS complex dissociated from sinus P-waves (asterisks) is seen.

anesthetic. The intracavity recordings showed the incessant and spontaneous presence of ectopic beats dissociated from atrial sinus activity, in which each QRS complex was preceded by His bundle deflection with a normal HV interval (Figure 2). Occasional sinus capture was observed. Complete ablation-type cartography of the interatrial septum was performed and did not show the existence of retrograde atrial conduction with the exception of the ectopic activity; an earlier electrogram showed the same His bundle deflection. Inhibition of tachycardia was also not observed at any time with mechanical manipulation of the catheters.

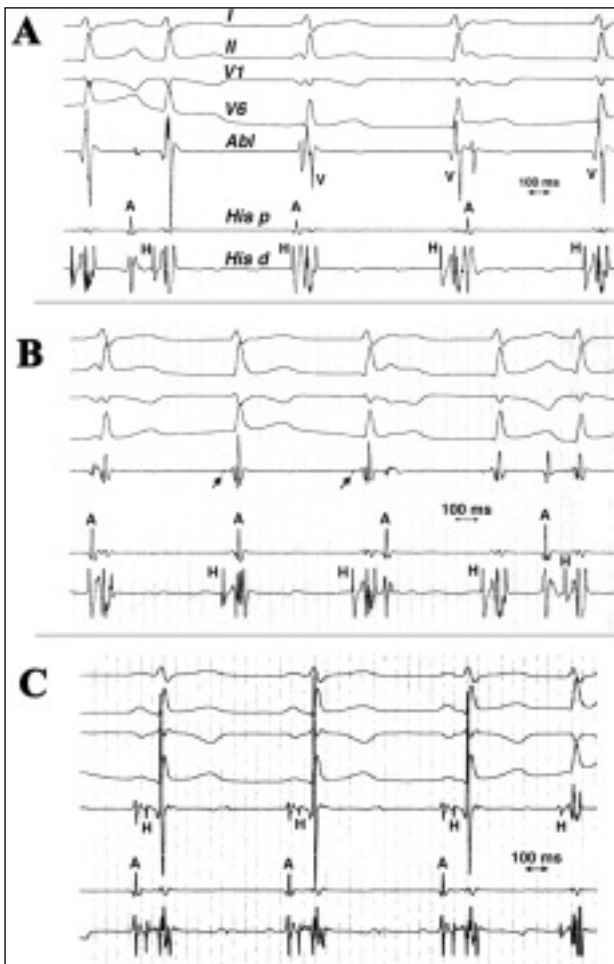
A total of 9 applications of radiofrequency were made empirically from the inferoparaseptal region, with applications progressively more anterosuperior and closer to the hisian area (Figure 3). On each application the initial temperature was fixed at 45 °C, with progressive increments of 2 °C to 3 °C up to a maximum of 55 °C if a rapid junction rhythm was not observed within the first 20 seconds of the application or AV block. This triggered a rapid junction rhythm with complete AV dissociation in 5 of the applications from the septal positions (Figure 3A). The superior displacements of the ablation catheter from these positions toward the hisian area were accompanied by a progressive decrease in the presence of ectopy of the junction competing with normal sinus automatism. Thus, applications in the same hisian area definitively abolished the ectopy (Figures 2C and 3C). Following the last 2 applications in the proximity of the major His deflection, development of a right branch conduction disturbance was observed that did not meet the criteria of a complete block (Figure 2C). Following the procedure, normal AV conduction was noted, with the establishment of a Wenckebach point with atrial

stimulation cycles of 250 milliseconds and an unchanged HV interval. At 3-month followup, the child remained asymptomatic, with no ectopic activity of the junction and with the disappearance of the conduction disturbance of the right branch.

## DISCUSSION

Non-paroxysmal automatic tachycardia of the AV junction is an infrequently occurring arrhythmia, initially described in children and infants and constituting less than 1% of all tachycardias. This pediatric form of arrhythmia has a natural history with an elevated mortality rate that reached 35% of the 26 cases in the broad series described by Villain et al,<sup>4</sup> with the cause of death including sudden infant death syndrome and its possible relationship with the myocardioathy that may accompany it. This form of presentation is substantially different from the usually transitory episodes of tachycardia that develop postoperatively in congenital heart disease.<sup>9</sup> We could not pinpoint the exact initiation of tachycardia in our patient, in whom arrhythmia appeared to be an incidental noncongenital finding. The poor prognosis of these forms of arrhythmia at an early age and the known limited response to anti-arrhythmic drugs results in pediatricians recommending radiofrequency ablation as the first therapeutic option before the appearance of signs suggestive of myocardioathy.

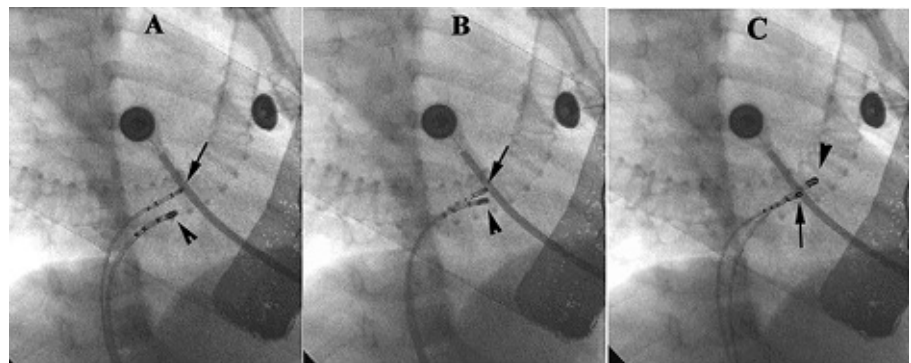
Both the spontaneous and incessant forms of presentation, competing with the sinus rhythm, and their palatine abolition during the ablation procedure implicate abnormal automatism as the most probable mechanism for this tachyarrhythmia. The result of radiofrequency lesions in the hisian region suggests that the automatic focus may be made up of transitional perihis-



**Fig. 2.** In the 3 panels from top to bottom: surface leads I, II, V1 and V6, in addition to intracavity recordings (amplitude, 0.5 mV/cm) with the ablation catheter (Abl) and with the proximal (p His) and distal (d His) ends of the catheter in the area of the hisigram. A) The ectopic rhythm at the beginning of the study can be observed, with the ablation catheter in the septal position (Figure 3A), with complete AV dissociation and a sinus capture. B) Recording with the ablation catheter approximately 4 mm below the distal bipole of the His catheter. Note the presence of minimal hisiana deflection (arrows) preceding each ectopic complex. C) The distal ablation catheter is located immediately anterior to the distal His catheter in the position from which ectopy was completely eliminated; only one beat of ectopy was observed in this sequence. Note the presence of a clear hisian deflection coincident with the His area. A indicates atrium; H, deflection of the His bundle; V, ventricle.

sian cells or, more likely, the His bundle itself, as the compact node has been described as lacking automaticity.<sup>10</sup> Although retrograde conduction, except for the ectopic focus, was not observed, there may have been an occult retrograde penetration of the AV node of the automatic hisian or perihisian heartbeats, as the AH interval during the few occurrences of sinus capture was more prolonged (100 milliseconds) than in normal sinus rhythm (55 milliseconds) following ablation.

Experience with using radiofrequency ablation this type of arrhythmias is scarce, and is composed of isolated cases and 1 series of 12 patients in a study by Hamdan et al.<sup>7</sup> We followed the anatomic strategy used by this group of researchers in for their cases in which, like our patient, the ectopic focus did not show evident retrograde conduction. In these patients they performed empirical applications in the inferoparaseptal area with progressively superior displacement if the tachycardia persisted. A more novel approach, in our case, was the step-by-step incremental application of a fixed temperature that allowed us to increase the safety margin during the procedure in order to avoid development of a possible irreversible AV block in a pediatric patient. Wu et al<sup>8</sup> reported their success in suppressing an ectopic focus that was also in the area of the His bundle via the careful application of low doses of radiofrequency energy (10 J). On the other hand, the application of radiofrequency ablation immediately before the major deflection of the hisian bundle distances it from the compact node and acts on the penetrating portion of the His bundle that is protected by the central fibrous body. Finally, the new cryoablation techniques, with temperatures for cartography of  $-30^{\circ}\text{C}$  that permit complete reversibility of tissue lesions,<sup>11</sup> are very promising for cases such as the one we report. At the time we performed our procedure cryoablation catheters had not yet been designed for pediatric patients. In any case, our report argues the case for invasive treatment with progressive and prudent use of radiofrequency ablation in these rare cases, in contrast with the much more conservative positions of other authors.<sup>12</sup>



**Fig. 3.** Position of the ablation catheters (arrow heads) and the hisigram recording (arrows) in the anteroposterior radiological view. Photographs A, B, and C reveal the position of the ablation catheter in the septal region, immediately below the lead with the maximum hisian deflection and immediately in front of this deflection, respectively. Each position corresponds to the respective intracavity recordings shown in Figure 2.

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