Atrial Pacing During Radiofrequency Ablation of Junctional Ectopic Tachycardia

A Useful Technique for Avoiding Atrioventricular Block

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Radiofrequency catheter ablation (RFCA) was performed on a 5-year-old boy with congenital junctional ectopic tachycardia (JET) that was refractory to medical management. Because of the lack of retrograde atrial depolarization during tachycardia, radiofrequency energy was delivered during atrial overdrive pacing to confirm the presence of preserved atrioventricular (AV) conduction. Although the procedure was complicated by complete right bundle branch block after ablation of the para-Hissian region, the patient regained sinus rhythm accompanied by normal AV conduction. Rapid atrial pacing during RFCA of JET may be safely used to avoid AV block. (Jpn Circ J 2001; 65: 242–244)

Key Words: Abnormal automaticity; Children; Retrograde atrial depolarization; Right bundle branch block; Unipolar recording

Because of its refractoriness to medical therapy and the high mortality rate,1–2 junctional ectopic tachycardia (JET) has been treated by ablation of the atrioventricular (AV) junction using either direct1 or radiofrequency (RF) current.3–4 However, these therapies may result in the need for permanent cardiac pacing. Recently, selective ablation of the JET focus while preserving normal AV conduction was reported5–9 suggesting that the junctional focus is usually perinodal and that ablative lesions created over the anterior, mid or posterior septum, avoiding the His bundle, may be effective. However, in the present patient we believed that the automatic focus of the JET existed at a site adjacent to the His bundle.

Case Report

The patient was a 5-year-old boy with a tachyarrhythmia that had been present since birth and had been well controlled with propranolol and digoxin. For the 6 months prior to admission, he had recurrent episodes of tachycardia accompanied by signs of congestive heart failure, including vomiting, appetite loss, and cyanosis. Pharmacologic management with multiple antiarrhythmic drugs (excluding amiodarone) failed, and the patient was referred for catheter ablation. The 24-h Holter monitoring showed an incessant irregular narrow QRS tachycardia with a rate of 180 beats/min. Echocardiography showed a reduced left ventricular shortening fraction (22%).

Two 5Fr quadripolar electrode catheters were introduced via the left femoral vein into the right high atrium and the right ventricle. A steerable 7Fr 20-pole catheter with a 2-mm interelectrode distance was placed across the tricuspid valve to record the AV junctional electrograms via a left femoral transvenous approach. A 6Fr 8-pole catheter was inserted from the right internal jugular vein into the coronary sinus. A baseline electrophysiologic study confirmed the diagnosis of JET based on the following observations: (1) during tachycardia, ventriculoatrial (VA) dissociation was present with a His potential always preceding the ventricular depolarization at an His-ventricular (HV) interval of 36 ms, (2) the earlier His potential recording was obtained by the more proximal electrode of the 20-pole catheter in the region expected to produce a His electrogram, (3) sinus beats that occasionally captured the ventricle caused a sudden shortening of the HH interval with subtle aberancy in the QRS configuration, but the HV intervals were the same as those during tachycardia, (4) there was no evidence of retrograde atrial activation in the His bundle or the coronary sinus during tachycardia, (5) atrial overdrive pacing during tachycardia caused temporary suppression of the tachycardia, confirming normal AV nodal conduction, (6) with the termination of atrial overdrive pacing, the tachycardia immediately resumed with a warming-up of the HH interval and subtle changes in the QRS configuration (Fig 1), and (7) the tachycardia could not be terminated with either atrial or ventricular programmed pacing.

A 7Fr ablation catheter (Medtronic CardioRhythm, Sunnyvale, CA, USA) was introduced via the right femoral vein into the area of the AV junction. To avoid AV block, we delivered RF current in the para-Hissian region where a His potential could not be detected by unipolar recording from the distal electrode of the ablation catheter (Fig 2A). There was no visible distance between the distal electrode of the ablation catheter and the second pair of electrodes of His bundle catheter (HB3–4) in any fluoroscopic view. RF current was delivered during atrial overdrive pacing to confirm the preservation of AV conduction, maintaining the electrode tip temperature at 70°C. Special care was
taken to interrupt the application of RF current immediately if junctional escape beats appeared during the energy delivery. Right bundle branch block (RBBB) was induced after 6 s, but the delivery of RF current was continued for another 24 s (Fig 3). However, the JET persisted with a RBBB morphology. The ablation catheter then was pulled back approximately 4–6 mm to a region where the His potential could be recorded by the unipolar lead of the first electrode (Fig 2B), and RF current was delivered again for 30 s during atrial overdrive pacing. There were no changes in the atrio-His (AH) or the HV intervals during the delivery of RF current. Termination of the JET was confirmed when atrial overdrive pacing was interrupted. The tachycardia could not be induced with atrial or ventricular programmed pacing, even after the administration of isoproterenol. In the electrophysiologic study after the successful ablation, the AH interval was 56 ms and the HV interval was 36 ms. Atrial extrastimulation during a driving cycle length of 400 ms demonstrated that an antegrade AV conduction was decremental without a “jump” of the A2H2 interval. The HV interval was 36 ms and constant during atrial extrastimulus protocol. The AV node effective refractory period was 210 ms. There was no demonstrable VA conduction with ventricular pacing.

There was no recurrence of the JET for 42 months. A repeat echocardiogram performed 3 months after ablation
revealed improved left ventricular systolic function, with a shortening fraction of 36%.

**Discussion**

JET is caused by abnormally enhanced automaticity within the AV node and successful radiofrequency catheter ablation (RFCA) of the JET foci without resultant AV block has been recently reported. Hamdan et al applied RF current at the site of the earliest retrograde atrial activation during sinus rhythm in 9 patients with JET, and successful ablation without AV block was achieved in 7 of them. During sinus rhythm in 9 patients with JET, and successful RF current at the site of the earliest retrograde atrial activation can be ablated successfully by application. We decided on the para-Hissian region as the ablation site in the present patient for the following reasons: (1) empirically, (2) by observing the termination of JET by mechanical manipulation of the ablation catheter or (3) by observing the rate acceleration during a low-dose RF energy application. We decided on the para-Hissian region as the ablation site in the present patient for the following reasons: (1) there was no evidence of retrograde atrial activation during JET, (2) it was considered to be safer to apply RF current in a region where a relatively small atrial potential and a large ventricular potential (small A/V ratio) could be recorded, because the His bundle is protected by the central fibrous body, and (3) it has been reported that the para-Hissian accessory pathway can be ablated successfully by RF current with preservation of normal AV conduction.

In patients with incessant tachycardia, the delivery of RF current during JET may be necessary, but it can be difficult to determine the AV nodal conduction during ablation. Atrial overdrive pacing during tachycardia caused a temporary suppression of the JET and consequently normal AV nodal conduction can be confirmed. Obviously, the limitation of rapid atrial pacing during RFCA of the JET is the inability to detect the persistence of JET, which causes needlessly long application of the RF current. However, the application of RF current can be safely continued as long as AV conduction can be monitored during overdrive atrial pacing. Rapid atrial pacing during RF ablation of JET is a safe and useful technique for avoiding AV block in patients with or without VA conduction.

**References**