CASE REPORT

Successful radiofrequency catheter ablation of "clockwise" and "counterclockwise" bundle branch re-entrant ventricular tachycardia in the absence of myocardial or valvar dysfunction without detecting bundle branch potentials

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A case is reported of a patient with only isolated conduction abnormalities of the His-Purkinje system with no identifiable myocardial or valvar dysfunction, leading to "clockwise" and "counterclockwise" bundle branch re-entrant ventricular tachycardias (BBRVTs). The electrophysiological study showed infra-Hisian conduction system disease and two different inducible wide QRS complex tachycardias. Neither right bundle branch nor left bundle branch potentials were recorded despite extensive catheter manipulation. However, these tachycardias were diagnosed as BBRVTs by using entrainment manoeuvres and comparing the HV intervals during both sinus rhythm and the tachycardias. These tachycardias were eliminated by catheter ablation of the right bundle branch, using the morphology of the local electrograms and anatomical findings.

A 70 year old man presented to another hospital in July 1999 with palpitations and a wide QRS complex tachycardia of 211 beats/min with a right bundle branch (RBB) block configuration. Direct current cardioversion was performed after multiple intravenous antiarrhythmic drugs failed. The surface ECG during sinus rhythm showed first degree atrioventricular (AV) block and left axis deviation. Cardiac catheterisation showed a normal left ventricular size, wall motion, and ejection fraction, and coronary angiography showed normal coronary arteries. He was referred to our institution for electrophysiological study and catheter ablation in May 2000. Radionuclide angiography and echocardiographic evaluations showed no abnormalities.

ELECTROPHYSIOLOGICAL EVALUATION

Informed consent was obtained to perform a complete electrophysiological study with possible radiofrequency ablation. The patient stopped medication and underwent a baseline electrophysiological study. The baseline rhythm was sinus with a cycle length of 1080 ms, AH interval of 128 ms, and HV interval of 95 ms. The atrial and anterograde AV nodal refractory periods were normal. Neither dual AV nodal pathway physiology nor retrograde ventriculoatrial conduction was seen. During programmed right ventricular apex extrastimulation, a sustained wide QRS complex tachycardia was reproducibly induced (tachycardia 1). This tachycardia had a left bundle branch (LBB) block pattern, with a cycle length of 269 ms and an HV interval of 110 ms (fig 1). Spontaneous premature left ventricular complexes occurring when the His bundle was refractory terminated tachycardia 1. Just after termination of tachycardia 1, the impulse propagation from the sinus node initiated another wide QRS complex tachycardia. (tachycardia 2). This tachycardia exhibited an RBB block pattern, with a cycle length of 310 ms and an HV interval of 119 ms, identical to the clinical tachycardia (fig 1). In both tachycardias, AV dissociation was present and the HV intervals during the tachycardias were somewhat longer than that during the sinus rhythm. In addition, a stable His bundle electrogram preceded each ventricular activation, and the change in the HH interval preceded the change in the following VV interval. During the sinus rhythm, the left ventricular septum was activated before the right ventricular apex, but during tachycardia 1 the right ventricular apex was activated earlier, suggesting a right sided exit point. These findings strongly indicated that the mechanism of tachycardia 1 was bundle branch re-entry, involving anterograde propagation through the RBB and retrograde through the LBB.

Steerable mapping catheters were repositioned at multiple sites along the intraventricular septum in search of LBB and RBB potentials. Despite extensive catheter manipulation, we could not detect these potentials. Therefore, we attempted transient entrainment by pacing from the right ventricular apex during tachycardia 2. Continuous pacing was performed during the tachycardia for more than five seconds with a cycle length 15 ms shorter than that of the tachycardia. Transient entrainment with manifest fusion was exhibited, which did not display the same configuration as that recorded during pacing in the sinus rhythm from the same site and cycle length as during the entrainment. The HV interval of the entrained complexes was almost the same as that during tachycardia 2, implying that the His were integral parts of the circuit (fig 2). Therefore, we diagnosed tachycardia 2 as bundle branch re-entrant ventricular tachycardia (BBRVT), involving retrograde propagation through the RBB and anterograde activation through the LBB, but not intrafascicular re-entrant ventricular tachycardia. Although we attempted transient entrainment by pacing from the high right atrium during tachycardia 2, there was no 1:1 anterograde AV conduction at the tachycardia cycle length.

CATHETER ABLATION

A 7 French gauge steerable quadripolar catheter with a large distal electrode was inserted through the femoral vein and

Abbreviations: AV, atrioventricular; BBRVT, bundle branch re-entrant ventricular tachycardia; LBB, left bundle branch; RBB, right bundle branch

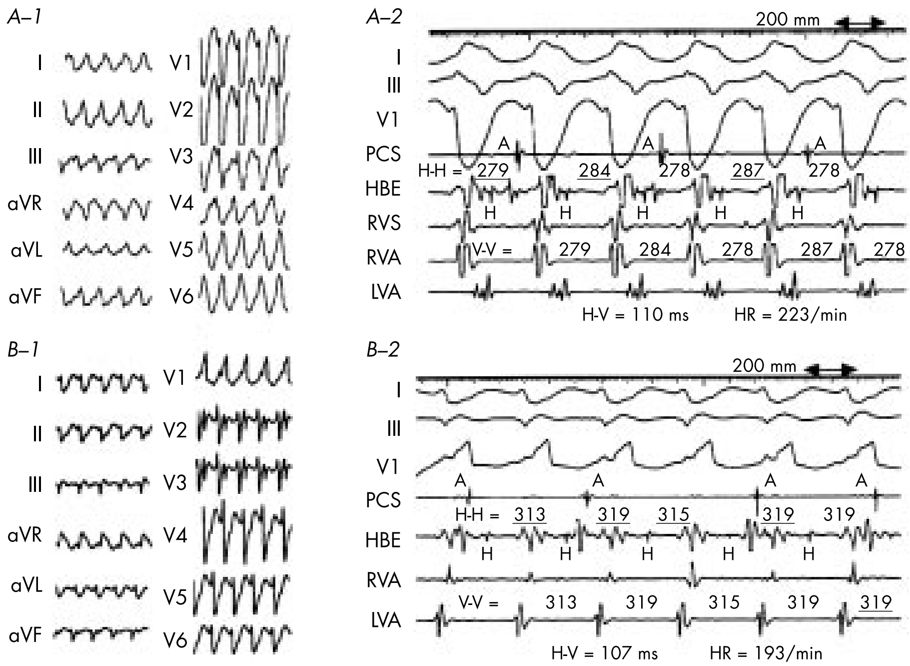

Figure 1 (A1) Twelve lead ECG during tachycardia 1 showing a left bundle brunch block pattern at a rate of 223 beats/min. (A2) Simultaneous recording of surface ECG leads I, III, and V1 and intracardiac electrograms from the proximal coronary sinus (PCS), His bundle electrogram (HBE), right ventricular apex (RVA), right ventricular septum (RVS), and left ventricular apex (LVA). AV dissociation was present and the HV interval during the tachycardia was 15 ms longer than that during the sinus rhythm. The His bundle electrogram preceded each QRS complex and His-His variations preceded VV changes. During the tachycardia, the right ventricular apex was activated before the left ventricular septum. (B1) Twelve lead ECG during tachycardia 2 showing a right bundle brunch block pattern at a rate of 193 beats/min. (B2) Simultaneous recording of surface ECG leads and intracardiac electrograms. AV dissociation was present and the HV intervals during the tachycardias were 12 ms longer than that during the sinus rhythm. The His bundle electrogram preceded each QRS complex and His-His variations preceded VV changes. During the tachycardia, the left ventricular septum was activated before the right ventricular apex. A, atrial electrogram; H, His bundle electrogram; V, ventricular electrogram.

advanced to the right sided intraventricular septum. The catheter position was verified in the right anterior oblique fluoroscopic view. Its tip was deflected toward the apex until no His bundle potential and a minimal atrial electrogram were recorded (fig 2). During the sinus rhythm, within four seconds after the onset of the radiofrequency energy application with a temperature setting of 60°, the surface ECG showed complete RBB block and the application was maintained for 60 seconds. During and after the energy delivery, no change in the HV interval was observed.

After the ablation, programmed ventricular stimulation no longer induced these ventricular tachycardias. The patient was

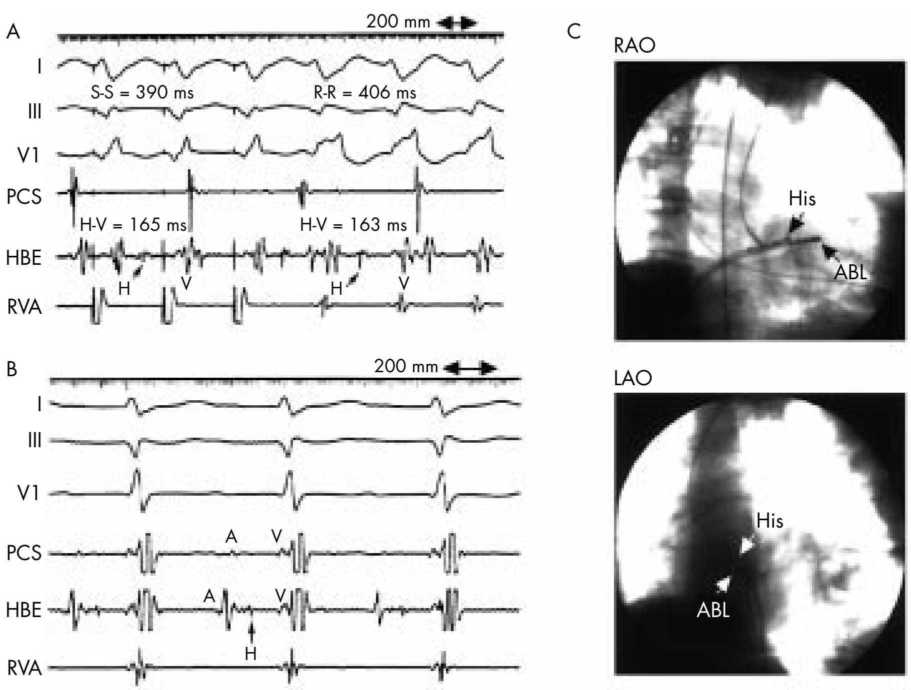

Figure 2 (A) Entrainment of tachycardia 2. The tachycardia had a cycle length of 406 ms and pacing was performed from the RVA at a cycle length of 390 ms. Constant fusion developed after the first several beats. The HV interval of the entrained complexes was almost the same as that during the tachycardia. (B, C) The successful ablation site. Panel B shows an intracardiac electrogram during the sinus rhythm. Note that no His bundle potential but minimal atrial electrogram was observed at the ablation site. The right bundle brunch potential was not detected. Panel C shows the ablation catheter position in the right anterior oblique (RAO) 30° and left anterior oblique (LAO) 60° fluoroscopic views. The large tipped catheter used for ablation (ABL, arrow) is positioned at the basal portion in the right ventricular anteroseptum.

followed up for 12 months after the procedure, taking no antiarrhythmic medications, with no recurrence of ventricular tachycardia or development of AV block.

DISCUSSION

We present a case report of a patient exhibiting "clockwise" and "counterclockwise" sustained BBRVTs with only isolated His-Purkinje system conduction abnormalities and no evidence of myocardial or valvar dysfunction.

In this case, no RBB or LBB electrograms could be obtained despite extensive catheter manipulation. In tachycardia 1, featuring an LBB block pattern, we discriminated BBRVT from other wide QRS complex tachycardias by using the criteria established for diagnosing BBRVT.[1–7] In contrast, with the RBB block pattern as in tachycardia 2, there are limitations to these approaches that can lead to failure to differentiate BBRVT from intrafascicular re-entrant ventricular tachycardia, which may also exhibit an RBB block pattern.[8] In our patient, the HV intervals during both tachycardias were somewhat longer than that during the sinus rhythm. In addition, we attempted transient entrainment by pacing from the right ventricular apex during the tachycardia, and the HV interval of the entrained complexes was almost the same as during the tachycardia. By using these findings, we concluded that the RBB was an integral part of the circuit in this tachycardia and diagnosed tachycardia 2 as clockwise BBRVT. We also diagnosed tachycardia 2 as BBRVT using the criteria that Merino and colleagues presented for diagnosing BBRVT without using His bundle or bundle branch electrograms.[9 10] Although they did not perform entrainment for intrafascicular re-entrant ventricular tachycardia, this manoeuvre was considered to be an indicator for differentiating BBRVT from this tachycardia.

In this study we showed that BBRVT could be terminated by radiofrequency catheter ablation of the RBB, using the morphology of the local electrogram without an RBB potential, in addition to the anatomical findings of fluoroscopy. This treatment approach was considered to be useful when it was difficult to record a stable or sufficiently sized RBB electrogram.

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