High-density mapping of the tachycardia circuit in atrioventricular nodal reentrant tachycardia

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Introduction

Electroanatomic mapping of tachycardia circuits can provide invaluable diagnostic and therapeutic advantages during electrophysiology study and catheter ablation procedures. However, they can be limited in their spatial and temporal resolution owing to a finite number of electroanatomic points collected manually. Classically, the reentrant circuit of atrioventricular node reentrant tachycardia (AVNRT) is contained within the fast and slow pathways of the AV node. This narrow anatomic window limits the effective electroanatomic mapping that can be performed. However, the availability of high-density mapping hardware coupled with automatic and accurate, rapid point acquisition may provide for the effective and detailed mapping and visualization of the AVNRT circuit.

Case report

A 75-year-old man with nonischemic cardiomyopathy, left ventricular dysfunction, nonobstructive coronary artery

Figure 1  Frozen activation map of atrioventricular node reentrant tachycardia (AVNRT), with yellow representing earlier activation “colliding” with late (purple) activation along the slow pathway region (using CS 5–6 as reference). The map shows the portion of activation illustrated (rainbow segment) out of the entire mapped cycle length (maroon circle). There is a slow-pathway potential noted on ablation catheter electrograms during sinus rhythm (right side, unipolar [U1:D6 and U1:D7] and bipolar [B:D6–7]).
disease, and status post biventricular implantable cardioverter-defibrillator placement was admitted for multiple inappropriate shocks due to supraventricular tachycardia with a short RP interval. At electrophysiology study, he was found to have dual AV nodal physiology with easily inducible, 1:1 tachycardia (cycle length = 388 ms). A “VAHV” response to right ventricular entrainment excluded atrial tachycardia and transient dissociation of the ventricle excluded AV reciprocating tachycardia. A diagnosis of typical AVNRT was made and a high-density electroanatomic map of the AVNRT circuit was created (Rhythmia; Boston Scientific) using a high-resolution, 64-electrode, spherical mapping catheter (IntellaMap Orion; Boston Scientific, Natick, MA). Electroanatomic mapping in the inferior aspect of the triangle of Koch revealed early atrial activation along the septum and a near-field slow-pathway potential during sinus rhythm (Figure 1; earliest activity in red). An animated propagation map of 4405 recorded electrograms demonstrated counterclockwise, typical AVNRT (Movie, available online; earliest activity in purple). Figure 2 demonstrates the electrograms during tachycardia and a posterior view of the AVNRT circuit. Activation on the coronary sinus catheter was slightly eccentric due to the catheter positioning. Ablation at the slow-pathway potential rendered the tachycardia uninducible. Additional mapping views are available in the Supplemental Material (Figures S1 and S2, available online).

Discussion
To our knowledge, this represents the first published report of a high-density activation map of the AVNRT circuit, without the use of a noncontact balloon. This case illustrates the ability of high-density mapping to allow novel visualization of activation in tachycardia circuits, while avoiding the limitation of noncontact mapping. Future application of high-density mapping technology may allow for the improved distinction between focal, autonomic arrhythmias

Figure 2: Alternative, posterior electroanatomic view with electrograms during tachycardia. The electroanatomic map displays the band of activation (rainbow segment) out of the entire mapped cycle length (maroon circle). Counterclockwise activation is illustrated (also see supplemental video). The coronary sinus electrograms show slightly eccentric activation due to catheter position with near zero ventriculoatrial activation time.
and those secondary to microreentrant circuits by assessing local activation patterns with high temporal-spatial resolution. This would be broadly applicable across arrhythmias, including sinus node reentry, atrial tachycardias, ventricular tachycardias, and preexcitation variants.

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Appendix
Supplementary data
Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.hrcr.2016.02.006.

Reference
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