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

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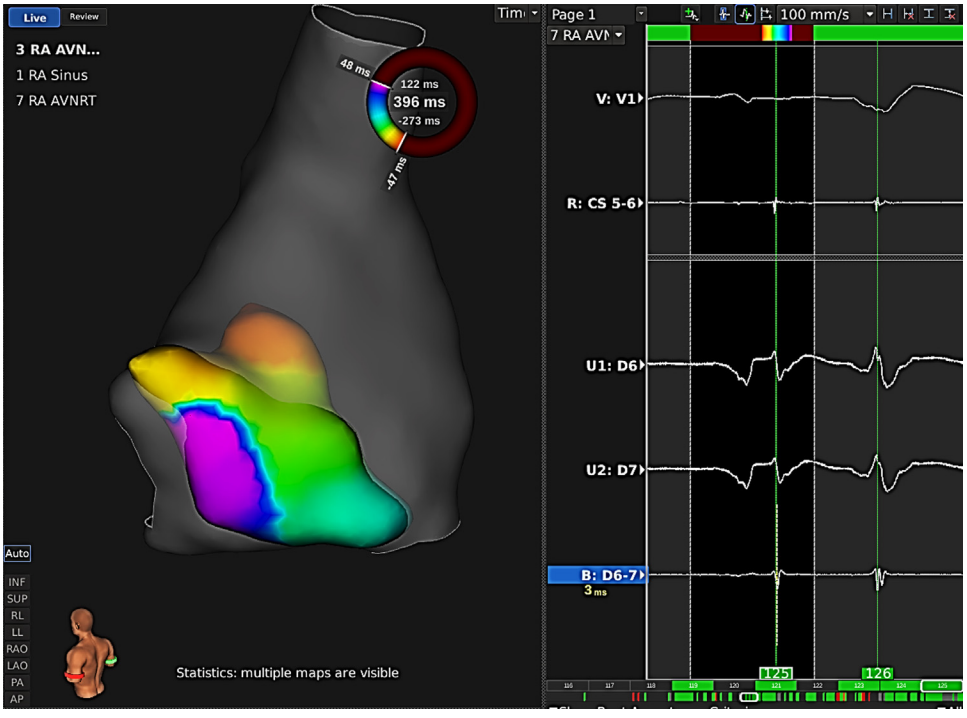

Figure 1 Frozen activation map of atrioventricular node reentrant tachycardia (AVNRT), with *yellow* representing earlier activation "colliding" with late (*purple*) activation along the slow pathway region (using CS 5–6 as reference). The map shows the portion of activation illustrated (rainbow segment) 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]).

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.

KEYWORDS AVNRT; Electroanatomic mapping; High-density; Rhythmia

(Heart Rhythm Case Reports 2016;2:451–453)

Dr Steinberg reports research support from Boston Scientific and modest educational support from Medtronic; Dr Piccini reports receiving grants for clinical research from ARCA biopharma, Boston Scientific, GE Healthcare, Johnson & Johnson, and ResMed as well as consultancies to Janssen Scientific Affairs and Spectranetics. **Address reprint requests and correspondence:** Dr Jonathan P. Piccini, Electrophysiology Section, Duke University Medical Center, Duke Clinical Research Institute, PO Box 17969, Durham, NC 27710. E-mail address: jonathan.piccini@duke.edu.

Case report

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

 http://dx.doi.org/10.1016/j.hrcr.2016.02.006

KEY TEACHING POINTS

- Mapping using high-density and rapid-activation acquisition can facilitate visualization of circuits that (1) are nonsustained, (2) are limited in geometric space, (3) are of short tachycardia cycle length, and/or (4) have highly dynamic activation.
- A thorough understanding of the typical atrioventricular node reentrant tachycardia circuit and anatomy is essential for the safe and effective catheter-based treatment of this arrhythmia.

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.[1] 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

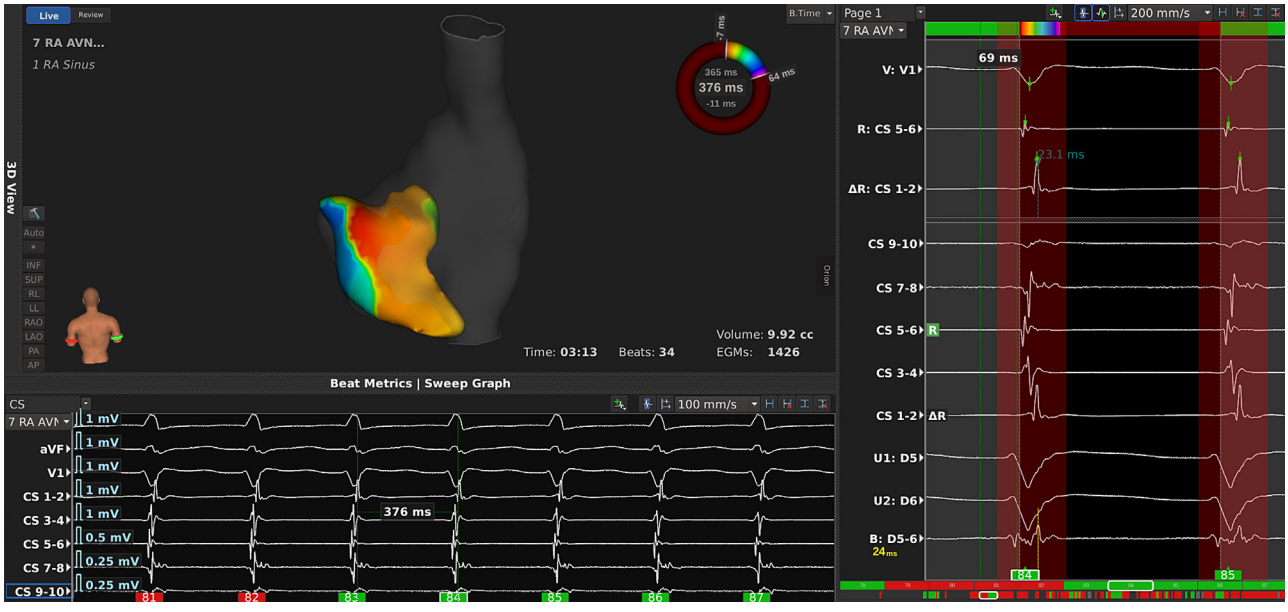

Figure 2 Alternative, posterior electoanatomic view with electrograms during tachycardia. The electroanatomic map displays the band of activation (rainbow segment) out of the entire mapped cycle length (marroon circle). Counterclockwise activation is illustrated (also see supplemental video). The coronary 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.

Acknowledgments

The authors wish to thank Richard Hood for his assistance in preparing the images and videos for this manuscript.

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

1. Lee PC, Tai CT, Lin YJ, Liu TY, Huang BH, Higa S, Yuniadi Y, Lee KT, Hwang B, Chen SA. Noncontact three-dimensional mapping guides catheter ablation of difficult atrioventricular nodal reentrant tachycardia. Int J Cardiol 2007;118:154–163.