Anterograde conduction to the His bundle during right ventricular overdrive pacing distinguishes septal pathway atrioventricular reentry from atypical atrioventricular nodal reentrant tachycardia

Koichi Nagashima, MD, PhD, Saurabh Kumar, MD, PhD, William G. Stevenson, MD, FHRS, Laurence M. Epstein, MD, Roy M. John, MD, PhD, FHRS, Usha B. Tedrow, MD, MSc, FHRS, Bruce A. Koplan, MD, MPH, FHRS, Gregory F. Michaud, MD, FHRS

From the Arrhythmia Unit, Cardiovascular Division, Brigham and Women's Hospital, Boston, Massachusetts.

BACKGROUND Distinguishing orthodromic atrioventricular reciprocating tachycardia (ORT) using a retrograde septal accessory pathway (AP) from atypical atrioventricular nodal reentrant tachycardia (AVNRT) may be challenging. Specifically, excluding the presence and participation of an AP may require multiple diagnostic maneuvers.

OBJECTIVE The purpose of this study was to assess the relative value of commonly used right ventricular (RV) pacing maneuvers, including identification of anterograde His-bundle activation with entrainment, to differentiate ORT using a retrograde septal AP from atypical AVNRT.

METHODS From March 2009 to June 2014, 56 patients (28 female; age 43.9 ± 17.4 years) who underwent electrophysiologic study and ablation for supraventricular tachycardia (26 ORT using septal AP and 30 atypical AVNRT) that exhibited a concentric atrial activation pattern and a septal ventriculoatrial interval >70 ms were analyzed.

RESULTS Overdrive pacing maneuvers or ventricular extrastimuli failed on at least 1 occasion to correctly identify a septal AP. Overall, 16 ORT patients and 26 AVNRT patients had successful RV entrainment, and 12 (75%) ORT patients showed anterograde His capture (11 patients) and/or anterograde septal ventricular capture (3 patients). None of the patients with atypical AVNRT showed anterograde conduction to the His bundle with entrainment.

CONCLUSION RV pacing maneuvers are useful to exclude an AP in patients with AVNRT having concentric atrial activation sequence and a septal ventriculoatrial interval >70 ms; however, none are consistently diagnostic. When observed in this patient population, anterograde His-bundle or septal ventricular capture during RV entrainment was diagnostic for ORT using a septal AP.

KEYWORDS Supraventricular tachycardia; Orthodromic reciprocating tachycardia; Atrioventricular nodal tachycardia; Accessory pathway; Entrainment; Constant fusion; Anterograde His capture

ABBREVIATIONS **AH** = atrial–His; **AP** = accessory pathway; **AV** = atrioventricular; **AVNRT** = atrioventricular nodal reentrant tachycardia; **ORT** = orthodromic atrioventricular reciprocating tachycardia; **PCL** = pacing cycle length; **PPI** = postpacing interval; **PVC** = premature ventricular contraction; **RV** = right ventricle; **SA** = stimulus–atrial; **SVT** = supraventricular tachycardia; **TCL** = tachycardia cycle length; **VA** = ventriculoatrial

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Introduction

Observations during right ventricular (RV) overdrive pacing are useful to determine the mechanism of supraventricular tachycardia (SVT),[1–7] but distinguishing orthodromic atrioventricular reciprocating tachycardia (ORT) using a retrograde septal accessory pathway (AP) from atypical atrioventricular nodal reentrant tachycardia (AVNRT) still is challenging. In this patient population, no single RV pacing maneuver is sensitive enough to reliably detect the presence of an AP, particularly one that is concealed and slowly conducting. The diagnosis of atypical AVNRT is made only after the presence of an AP has been excluded; therefore, multiple observations during RV overdrive pacing or extrastimuli often are necessary to gain sufficient confidence in this diagnosis.

Evidence of constant fusion of the surface QRS during entrainment from the RV is considered a diagnostic finding for ORT.[8] In ORT with constant QRS fusion, the His bundle is depolarized by the anterograde wavefront through the AV node. However, in atypical AVNRT, constant QRS fusion is absent, and the His bundle is depolarized by the retrograde

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paced wavefront in order to entrain the circuit. We hypothesized that direct observation of anterograde His capture during entrainment of septal ORT from RV pacing would be diagnostic without requiring subjective comparison of the surface QRS morphology during pacing in sinus rhythm.

The aim of this study was to assess the relative value of commonly used RV pacing maneuvers, including postpacing interval relative to tachycardia cycle length (PPI–TCL), stimulus–atrial interval relative to the ventriculoatrial interval (SA–VA), perturbation of atrial timing during premature ventricular contractions (PVCs) timed when the His bundle is refractory or during the zone of fusion at the beginning of overdrive pacing, and identification of anterograde His or septal ventricular conduction during entrainment in order to differentiate ORT using a retrograde septal AP from atypical AVNRT.

Methods

Study design

From March 2009 to June 2014, 56 patients (28 female; age 43.9 ± 17.4 years) who underwent electrophysiologic study and ablation for SVT that exhibited a concentric atrial activation pattern and a septal VA interval >70 ms were analyzed. Patients with multiple APs or SVT that exhibited spontaneous cycle length (CL) oscillation >20 ms within 3 cycles of the onset of RV overdrive pacing were excluded. Each patient gave written informed consent. Studies and data collection were performed according to protocols approved by the Human Research Committee of Brigham and Women's Hospital.

Electrophysiologic study

Procedures were performed with patients under conscious sedation. Using femoral venous access, quadripolar electrode catheters were positioned in the high right atrium, RV apex or base, and His-bundle region, and a decapolar catheter was positioned in the coronary sinus. Twelve-lead ECGs and bipolar intracardiac electrograms bandpass filtered from 30 to 500 Hz were recorded and stored on a digital recording system (CardioLab EP, GE Healthcare, Wilmington, MA) at speeds of 100 to 200 mm/s. Bipolar pacing was used at twice diastolic threshold from the distal electrode pair. The onset of RV overdrive pacing was timed to begin on the basis of sensing from the RV catheter so that the coupling interval between the last sensed RV electrogram and the first paced beat approximated the pacing cycle length (PCL). Improperly timed RV overdrive pacing trains were excluded from analysis.

Entrainment

Diagnostic maneuvers were assessed according to the flowchart shown in Figure 1. In all patients, entrainment of the tachycardia was attempted by RV overdrive pacing at a CL 10 to 40 ms shorter than the TCL. Entrainment was confirmed when the atrial CL accelerated to the PCL, without a change in the atrial activation sequence, and the tachycardia resumed after pacing cessation. The longest PCL clearly resulting in entrainment was used for analysis. The TCL and interval between the onset of the QRS complex and the earliest atrial electrogram (VA interval) were measured in the cycle immediately before pacing. The SA interval was measured from the last RV pacing stimulus during

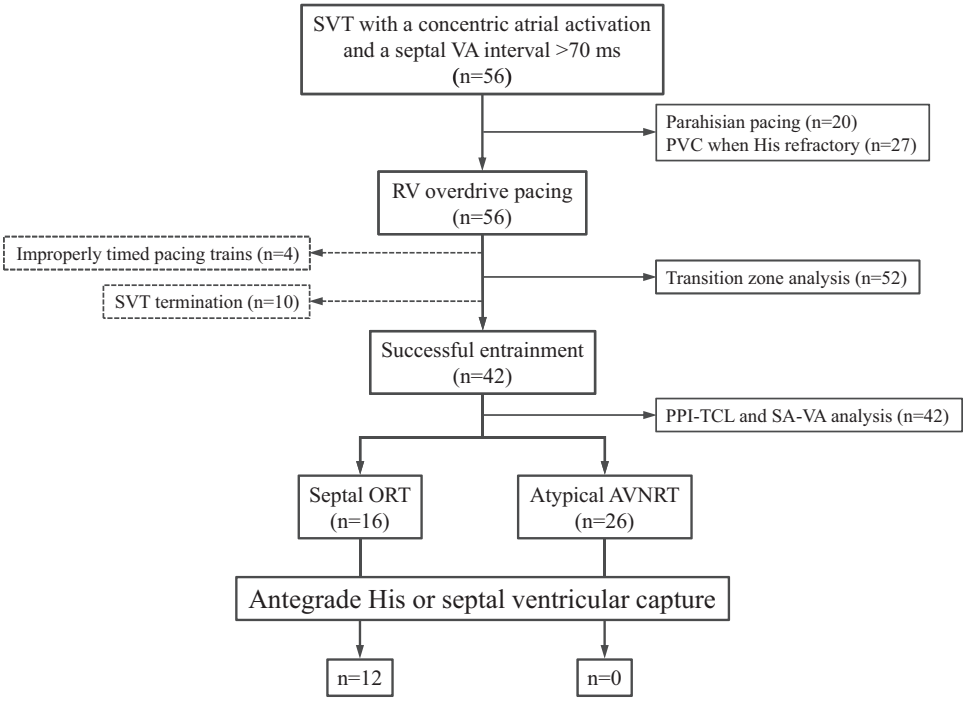

Figure 1 Flowchart showing the diagnostic maneuver details for differentiating the supraventricular tachycardia (SVT) mechanism. AVNRT = atrioventricular nodal reentrant tachycardia; ORT = orthodromic reciprocating tachycardia; PPI = postpacing interval; PVC = premature ventricular contraction; RV = right ventricle; SA = stimulus–atrial; TCL = tachycardia cycle length; VA = ventriculoatrial.