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Use of Programmed Ventricular Extrastimulus During Supraventricular Tachycardia to Differentiate Atrioventricular Nodal Re-Entrant Tachycardia From Atrioventricular Re-Entrant Tachycardia

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ABSTRACT

OBJECTIVES This study hypothesized that early coupled ventricular extrastimuli (V_2) stimulation might yield a more robust differentiation between atrioventricular nodal re-entrant tachycardia (AVNRT) and atrioventricular re-entrant tachycardia (AVRT).

BACKGROUND Programmed V_2 during supraventricular tachycardia are useful to differentiate AVNRT from AVRT by subtracting the ventriculoatrial (VA) interval from the stimulus to atrial depolarization (stimulus atrial [SA]) interval, but all such maneuvers have limitations.

METHODS Patients with either AVNRT or AVRT were investigated. The entire tachycardia cycle length (TCL) was scanned with V_2 delivered from the right ventricular apex. The SA−VA difference was calculated with V_2 clearly resetting the tachycardia. The prematurity of V_2 was calculated by dividing the coupling interval (CI) by the TCL.

RESULTS A total of 210 patients (102 with AVNRT) were included. The SA−VA difference was >70 ms in all AVNRT patients and was <70 ms in all AVRT patients with right and septal accessory pathways (APs), except for those with decremental APs, in whom there was an overlap between AVNRT and AVRT with left APs. However, a SA−VA difference >110 ms with a CI/TCL of <65% distinguished AVNRT from AVRT using the left AP, with sensitivity and specificity of 87% and 100%, respectively. Ventricular overdrive pacing resulted in tachycardia termination or AV dissociation in 28% of patients compared with 15% of patients using the V_2 technique ($p = 0.008$).

CONCLUSIONS A SA−VA of >70 ms using the V_2 technique differentiated AVNRT from AVRT using septal and right APs. Use of the V_2 technique with a short CI differentiated AVNRT from AVRT using left APs. The V_2 technique less frequently resulted in tachycardia termination compared with ventricular entrainment. (J Am Coll Cardiol EP 2018;■:■-■) © 2018 by the American College of Cardiology Foundation.

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ABBREVIATIONS AND ACRONYMS

AP = accessory pathway

AVNRT = atrioventricular nodal re-entrant tachycardia

AVRT = atrioventricular re-entrant tachycardia

CI = coupling interval

CS = coronary sinus

PPI = post-pacing interval

RV = right ventricular

TCL = tachycardia cycle length

SA = stimulus atrial

VA = ventriculoatrial

Various maneuvers have been reported to differentiate the mechanism of supraventricular tachycardias. Ventricular entrainment is one of the most useful maneuvers to identify atrial tachycardia by confirming the atrial-atrial-ventricular response (1) and to distinguish atrioventricular nodal re-entrant tachycardia (AVNRT) from atrioventricular re-entrant tachycardia (AVRT) by using the difference between the stimulus atrial (SA) interval after ventricular entrainment and the ventriculoatrial (VA) interval during tachycardia or using the difference between the post-pacing interval (PPI) and tachycardia cycle length (TCL) (2–4). However, this maneuver often results in termination of the tachycardia or in AV dissociation, which has been found to occur in 5% to 65% of patients (5–9). By contrast, it has been reported that determination of SA−VA after resetting with ventricular extrastimuli (V_2) is also useful in differentiating AVNRT from AVRT, but there is still overlap in this parameter between AVNRT and AVRT using a free wall accessory pathway (AP) (10). Although many maneuvers have been described to differentiate AVNRT from AVRT, all of them have limitations.

The purpose of this study was to test these hypotheses: 1) whether programmed right ventricular (RV) V_2 that reset the tachycardia would be equivalent to or superior to ventricular entrainment to distinguish AVNRT from AVRT; and 2) whether the use of early coupling intervals (CIs) might enhance differentiation of AVNRT from AVRT.

METHODS

PATIENT CHARACTERISTICS. Consecutive patients with AVNRT or AVRT who underwent electrophysiological studies in participating centers between January 2012 and August 2016 were investigated (prospectively after April 2015). Patients were excluded if there were ≥2 tachycardia mechanisms, tachycardia was not sustained, or TCL varied >30 ms. Patients with antidromic AVRT were also excluded. We evaluated clinical characteristics, including age, sex, body mass index, ejection fraction, and presence of cardiac disease.

ELECTROPHYSIOLOGICAL STUDY. Electrophysiological studies were performed using standard techniques after obtaining written informed consent. All antiarrhythmic drug therapies were discontinued at least 5 half-lives before the procedure. Quadripolar electrode catheters were inserted into the femoral vein and positioned in the high right atrium, anteroseptal tricuspid valve (His bundle recording), and RV apex. A decapolar electrode catheter was also inserted into either the femoral vein or the internal jugular vein and positioned in the coronary sinus (CS). Twelve-lead surface electrocardiograms and intracardiac electrograms were recorded and stored on the Prucka CardioLab (GE Healthcare, Little Chalfont, United Kingdom) recording system. Bipolar intracardiac electrograms were filtered between 30 and 500 Hz and recorded at a speed of 100 mm/s. Bipolar pacing was performed at twice the diastolic threshold from the distal electrode pair.

Tachycardia was induced by programmed stimulation from the RV apex and the high right atrium. If the tachycardia was not inducible or not sustained at baseline, isoproterenol was infused continuously to accelerate the sinus rate by >20% or to a sinus rate >100/min, and programmed stimulation was repeated. Atrial tachycardia was excluded by the presence of a ventricular-atrial-ventricular response after RV entrainment of the tachycardia. The diagnoses of AVNRT or AVRT were made according to conventional electrophysiological criteria (4,6), and the results of a successful ablation site. Patients were defined as having a slowly conducting AP if the VA/TCL was ≥40%; they were also defined as having a nondecremental AP if the VA/TCL was <40% (11). AP sites were divided into right-sided, septal, and left free wall pathways.

Entrainment of the tachycardia was attempted with RV apical pacing at a cycle length of 10 to 30 ms shorter than the TCL. Entrainment was confirmed when the atrial cycle length was accelerated to the pacing cycle length with the same atrial activation sequence, and the tachycardia resumed after stopping the pacing train. The V_2 technique was performed by delivering a single RV extrastimulus starting from a CI 10 ms shorter than the TCL. The CI was decreased in 10-ms steps until resetting occurred or the ventricular effective refractory period was reached. Resetting was confirmed when the atrial

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