Electrophysiological Features Differentiating the Atypical Atrioventricular Node–Dependent Long RP Supraventricular Tachycardias

Reginald T. Ho, MD, FHRS; Daniel R. Frisch, MD; Behzad B. Pavri, MD; Steven A. Levi, MD; Arnold J. Greenspon, MD

Background—Diagnosing atypical atrioventricular node-dependent long RP supraventricular tachycardias (SVTs) can be challenging.

Methods and Results—Nineteen patients with 20 SVTs (atypical atrioventricular nodal reentrant tachycardia without [n=11]/with [n=3] a bystander nodofascicular [NF] accessory pathway, orthodromic reciprocating tachycardia [ORT] using a decremental atrioventricular [permanent form of junctional reciprocating tachycardia; n=4] or NF [NF reentrant tachycardia; n=2]) accessory pathway underwent electrophysiological study. Postspacing interval (PPI)–tachycardia cycle length (TCL), corrected PPI, ∆VA (ventriculoatrial), ∆HA (His-atrial), ∆AH (atrio-His) values, and responses to His-refractory ventricular premature depolarizations were studied. Compared with atrophicventricular nodal reentrant tachycardia, ORT patients were younger (42±13 years versus 54±19 years; P=0.036) and were women (5/6 [83%] versus 3/14 [21%]; P=0.036); TCLs were similar (435 ms versus 429 ms; 95% confidence interval, −47.5 to 35.5). PPI–TCL was shorter for ORT (118 ms versus 176 ms; 95% confidence interval, 26.3–89.7) but only 50% had PPI–TCL <115 ms, whereas 5 of 6 (83%) had PPI–TCL <125 ms (sensitivity, 83%; specificity, 100%). Corrected PPI <110 ms, ∆VA <85 ms, and ∆HA <0 ms had equivalent sensitivity (67%) and 100% specificity for ORT. Compared with permanent form of junctional reciprocating tachycardia, NF reentrant tachycardia/atrioventricular nodal reentrant tachycardia had longer ∆AH (29 ms versus 10 ms; 95% confidence interval, 3.03–35.0) or AH(SVT)<AH(NSR) (normal sinus rhythm) His-refractory ventricular premature depolarizations advanced (4/8 [50%]), delayed (4/8 [50%]), or terminated (5/8 [63%]) SVT in all accessory pathway patients.

Conclusions—This unusual SVT requires separate maneuvers to delineate its upper and lower circuit. Standard entrainment criteria are modestly sensitive but highly specific for ORT; and PPI–TCL of 125 ms seems better than 115 ms. The ∆AH criteria, or paradoxically AH(SVT)<AH(NSR), differentiates NF reentrant tachycardia/atrioventricular nodal reentrant tachycardia from permanent form of junctional reciprocating tachycardia. Bystander accessory pathways were only identified by His-refractory ventricular premature depolarizations. (Circ Arrhythm Electrophysiol. 2013;6:597-605.)

Key Words: accessory pathway ■ atrioventricular node ■ catheter ablation ■ entrainment ■ nodofascicular ■ nodoventricular ■ resetting ■ supraventricular tachycardia

Received October 31, 2012; accepted April 9, 2013.
From the Department of Medicine, Division of Cardiology, Thomas Jefferson University Hospital, Philadelphia, PA (R.T.H., D.R.F., B.B.P., A.J.G.); and Division of Cardiology, Our Lady of Lourdes Hospital, Camden, NJ (S.A.L.).
Correspondence to Reginald T. Ho, MD, Department of Medicine, Division of Cardiology, Thomas Jefferson University Hospital, 925 Chestnut St, Mezzanine Level, Philadelphia, PA 19107. E-mail reginald.ho@jefferson.edu

© 2013 American Heart Association, Inc.

Circ Arrhythm Electrophysiol is available at http://circep.ahajournals.org

DOI: 10.1161/CIRCEP.113.000187

Clinical Perspective on p 605
Methods

Nineteen patients with 20 symptomatic atypical long RP SVTs underwent diagnostic electrophysiological study. After informed consent, femoral vein access was achieved percutaneously, and multipolar catheters were positioned in the right atrium, His bundle region, right ventricle, and coronary sinus. Programmed stimulation and burst pacing were delivered from the ventricle and atrium to evaluate retrograde and antegrade conduction, respectively, and induce SVT. If SVT was noninducible in the baseline state, isoproterenol was infused and the stimulation protocol was repeated. After tachycardia induction, voltage mapping was performed to define the tachycardia circuit. Ventricular premature depolarizations (VPDs) were delivered during the diastolic period of tachycardia, and SVT was entrained from the ventricle at a pacing cycle length of 10 to 50 ms shorter than tachycardia cycle length (TCL). Para-Hisian pacing and entrainment were performed selectively to confirm diagnoses.9 Radiofrequency ablation was performed in all patients by targeting either the SP or the AP after activation mapping or SP using the standard approach during sinus rhythm.10

Definition of Terms

Post-pacing interval (PPI): time between the pacing stimulus to the first return right ventricular electrogram after entrainment of tachycardia from the ventricle.11

- Corrected PPI (cPPI): PPI/TA–AH(TCL

- Delta AH(AV) = AH(ventricle)–AH(SVT)

- Delta VA(VA) = VA(entrainment from ventricle)–VA(TCL)

- Delta HA(HA) = HA(entrainment from ventricle)–HA(SVT)

Diagnostic Criteria for SVT

All tachycardias had a long RP (RP>PR) interval with earliest atrial activation near the ostium of the coronary sinus. Atrial tachycardia was excluded by the following criteria: (1) spontaneous termination with AV block; (2) termination of tachycardia by VPDs that failed to reach the atrium (VA block), and (3) A-A-V response to entrainment from the ventricle.11 The following criteria established a diagnosis of:

- Atypical AVNRT: (1) obligatory 1:1 AV relationship; (2) VA/TCL prolongation with the development of BBB; (3) His-refractory VPDs reset the atrium or terminate tachycardia with VA block; (4) ability to entrain tachycardia from the ventricle with orthodromic capture of the His bundle; (5) PPI–TCL≥115 ms (or cPPI≥110 ms); (6) ΔVA≥85 ms; (7) ΔHA>0 ms; and (8) ΔAH>40 ms (or paradoxically, AH<SVT<AH<NSR).

- PJRT: (1) obligatory 1:1 AV relationship; (2) VA/TCL prolongation with the development of BBB; (3) His-refractory VPDs reset (advance or delay) the atrium or terminate tachycardia with VA block; (4) ability to entrain tachycardia from the ventricle with orthodromic capture of the His bundle; (5) PPI–TCL<115 ms (or cPPI<110 ms); (6) ΔVA<85 ms; (7) ΔHA=0 ms; and (8) ΔAH<0 ms (or paradoxically, AH>SVT>AH<NSR).

- NFRT: (1) obligatory 1:1 AV relationship (persistence of tachycardia, despite retrograde block to the atrium or antegrade block to the ventricle); (2) failure of BBB to affect tachycardia; (3) His-refractory VPDs reset (advance or delay) the atrium or terminate tachycardia with VA block; (4) ability to entrain tachycardia from the ventricle with orthodromic capture of the His bundle; (5) PPI–TCL<115 ms (or cPPI<110 ms); (6) ΔVA<85 ms; (7) ΔHA<0 ms; and (8) ΔAH>40 ms (or paradoxically, AH<SVT<AH<NSR).

- Atypical AVNRT/NF AP: (1) obligatory 1:1 AV relationship (persistence of tachycardia, despite retrograde block to the atrium or antegrade block to the ventricle); (2) failure of BBB to affect tachycardia; (3) His-refractory VPDs reset the atrium or terminate tachycardia with VA block; (4) ability to entrain tachycardia from the ventricle with orthodromic capture of the His bundle; (5) PPI–TCL≥115 ms (or cPPI≥110 ms); (6) ΔVA≥85 ms; (7) ΔHA>0 ms; and (8) ΔAH>40 ms (or paradoxically, AH<SVT<AH<NSR).

Statistics

Continuous data are expressed as mean±SD or 95% confidence interval (CI). Categorical data are presented as frequency and percentage. The Student t test and comparison of proportions were used to compare differences between groups. P values ≤0.05 were considered significant.

Results

The 20 atypical long RP SVTs in 19 patients included pure atypical AVNRT (n=11), atypical AVNRT/NF AP (n=3), PJRT (n=4), and NFRT (n=2). One patient had both NFRT and atypical AVNRT/NF AP. All APs were concealed and none demonstrated antegrade conduction. Illustrative cases are shown in Figures 1–4. Compared with atypical AVNRT, patients with ORT (PJRT/NFRT) were younger, more often women but TCLs were similar (Table 1).

Entrainment From Ventricle

A-A-V patterns were common and occurred more frequently with atypical AVNRT than ORT (79% versus 17%; P=0.036). They were pseudo A-A-V patterns in 9 of 12 (atypical AVNRT [n=8], PJRT [n=1]) and true A-A-V responses in the remaining 3 (atypical AVNRT with [n=2] and without [n=1] NF AP). Although the PPI–TCL was shorter for ORT (118 ms versus 176 ms; 95% CI, 26.3–89.7), half had a PPI–TCL≥115 ms (sensitivity [SN], 50%; specificity, 100%; positive predictive value, 100%). In contrast, PPI–TCL≤125 ms occurred in 5 of 6 ORT and 0 of 14 AVNRT (SN, 83%; specificity, 100%; positive predictive value, 100%; Figure 5). The cPPI was also shorter for ORT (115 ms versus 170 ms; 95% CI, 21.7–88.3), but 2 of 6 ORT had a value ≥110 ms, both associated with antidromic capture of the His bundle (SN, 67%; specificity, 100%). The ΔVA was smaller for ORT (101 ms versus 160 ms; 95% CI, 25.9–42.2) but 2 of 6 ORT had a value ≥85 ms (SN, 67%; specificity, 100%). His bundle electrograms were identifiable during entrainment in 17 of 20 (85%) SVTs and were captured orthodromically in ORT (n=4) and antidromically in 13 (AVNRT [n=1], ORT [n=2]). The ΔHA was smaller for ORT (~1 ms versus 72 ms; 95% CI, 35.6–110) but 2 of 6 ORT had a value >0 ms (SN, 67%; specificity, 100%).

His-Refractory VPDs

His-refractory VPDs reset or terminated tachycardia in all 8 patients with an AP and was the only maneuver to identify a concealed, bystander NF AP during atypical AVNRT. They advanced the atrium in 4 APs (AV AP [n=3], NF AP [n=1]), delayed it in 4 (NF AP [n=3], AV AP [n=1]), and terminated SVT with VA block in 5 (NF AP [n=3], AV AP [n=2]). All 4 APs exhibiting paradoxical delay was associated with PPI–TCL>125 ms.

Other Criteria

Compared with PJRT, the ΔAH was longer for NFRT/atypical AVNRT (29 ms versus 10 ms; 95% CI, 3.03–35.0); and 3 SVTs (atypical AVNRT/NF AP [n=2], NFRT [n=1]) had
an AH interval paradoxically shorter than that during sinus rhythm. Para-Hisian pacing was unhelpful in 14 of 19 (74%) patients because either fast pathway (FP) conduction always preempted slower SP/AP conduction during pacing (n=12) or consistent 1:1 conduction over the SP/AP could not be achieved, despite pacing at the slowest rate allowable by sinus rhythm (n=2). Para-Hisian entrainment was successfully performed in only 2 patients and confirmed the established diagnosis.

Nodal Pathways
The proximal insertion of all 4 nodal APs was the SP of the AV node. In 1 patient, it was the left atrionodal extension of the SP requiring ablation along the postero-septal mitral annulus. The distal insertion of the nodal APs was fascicular (para-Hisian pacing [n=1], para-Hisian entrainment [n=1]; Figure 4), ventricular (manifest QRS fusion during entrainment [n=1]; Figure 2), and indeterminate (n=1).

Ablation
The successful ablation site for all patients with atypical AVNRT with and without a bystander NF AP was the SP of the AV node along the postero-septum of the right atrium and includes the patient with both atypical AVNRT/NF AP and NFRT. The other patient with NFRT had an AP inserting into the left atrionodal extension of the SP and required ablation along the postero-septal mitral annulus. All patients with PJRT had successful AP ablation along the postero-septum of the tricuspid annulus near the ostium of the coronary sinus identified by activation mapping during tachycardia.

Discussion
Compared with atypical AVNRT, patients with ORT (NFRT/PJRT) were younger and predominantly women, although the demographics may be skewed by the small study population. These long RP tachycardias respond differently than their short RP counterparts to pacing maneuvers; and the rare tachycardia associated with a NF AP can be misdiagnosed as PJRT if the upper circuit is not analyzed. Therefore, separate pacing maneuvers in the atrium and ventricle are required to delineate the upper and lower circuit, particularly when a 1:1 AV relationship exists (Figure 6; Table 2).
Entrainment From Ventricle

Although A-A-V responses are generally considered diagnostic of AT, A-A-V patterns were common in our series, particularly for atypical AVNRT with its longer paced VA interval. Pseudo A-A-V patterns occur when decremental conduction over the SP or AP produced long VA intervals that exceed the pacing cycle length so that the first atrial electrogram after entrainment is actually driven by the penultimate pacing stimulus. True A-A-V responses were the result of dual retrograde responses (double fire) with simultaneous conduction over the FP and NF AP or SP occurring only with atypical AVNRT with and without a concealed, bystander NF AP, respectively. This is different from the A-A-V response of AT, which results from retrograde conduction over the AV node followed by the first return beat of AT after pacing. A mechanism to explain dual retrograde (A-A-V) responses during atypical AVNRT is the presence of a large excitability gap with collision between antidromic and orthodromic wavefronts in the SP (retrograde limb) of the circuit. The last (n) paced antidromic wavefront has no antidromic wavefront with which to collide, conducts over the SP to activate the atrium (first A) and then collides with the previous (n−1) orthodromic wavefront in the SP. The last (n) paced orthodromic wavefront has no antidromic wavefront with which to collide, conducts over the SP to activate the atrium (first A) and then collides with the previous (n−1) orthodromic wavefront in the SP. The last (n) paced orthodromic wavefront has no antidromic wavefront with which to collide, conducts over the SP to activate the atrium (first A) and then collides with the previous (n−1) orthodromic wavefront in the SP. The last (n) paced orthodromic wavefront has no antidromic wavefront with which to collide, conducts over the SP to activate the atrium (first A) and then collides with the previous (n−1) orthodromic wavefront in the SP. The last (n) paced orthodromic wavefront has no antidromic wavefront with which to collide, conducts over the SP to activate the atrium (first A) and then collides with the previous (n−1) orthodromic wavefront in the SP. The last (n) paced orthodromic wavefront has no antidromic wavefront with which to collide, conducts over the SP to activate the atrium (first A) and then collides with the previous (n−1) orthodromic wavefront in the SP.
long PPI during ORT when both retrograde AP and antegrade AV node decrement occurred—the latter from antidromic capture of the His bundle and retrograde concealment into the AV node. However, when substantial delay occurred over the AP, the cPPI could not correct the long PPI and even paradoxically prolonged it because the first return AH became shorter than during SVT. Slow, decremental AP conduction also affected the SN of the $\Delta VA$ and $\Delta HA$ criteria for ORT but maintained their high SP. Therefore, any standard criteria positive for ORT (PPI–TCL<115 ms, cPPI<110 ms, $\Delta VA$<85 ms, and $\Delta HA$<0 ms) was diagnostic of ORT, despite discordance among each other which occurred 50% of the time.

**His-Refractory VPDs**

His-refractory VPDs that reset (advance or delay) or terminate tachycardia indicate the presence of an AP but not necessarily its participation in tachycardia. They can reset or terminate atypical AVNRT in the presence of a concealed, bystander NF AP inserting into the retrograde SP. In such a case, the VPD conducts over the NF AP ahead of the AVNRT wavefront and penetrates its excitable gap in the SP after the lower turnaround point of the circuit. Its antidromic wavefront collides with tachycardia, whereas its orthodromic wavefront encounters either relative or absolute distal SP refractoriness delaying or terminating tachycardia, respectively. His-refractory VPDs identified an AP in all patients with ORT and was the only pacing maneuver to diagnose a concealed, bystander NF AP in 3 patients with atypical AVNRT by delaying the atrium and terminating tachycardia with VA block. Although entrainment of atypical AVNRT/NF AP from the ventricle with orthodromic capture of the His bundle is theoretically possible, it was not observed. His-refractory VPDs also determined the degree of decremental conduction over each AP. Severe AP decrement paradoxically delayed the atrium because the degree of VPD prematurity was offset by a greater than or equal degree of AP conduction delay (fully compensatory). Mild AP decrement advanced the atrium because the degree of VPD prematurity was offset by a lesser degree of AP conduction delay (partially compensatory). Paradoxically delay might identify patients who have long PPIs after entrainment independent of tachycardia mechanism.
Other Criteria
The $\Delta AH$ criteria differentiates tachycardia circuits whose upper portion is partially extranodal (PJRT) or completely intranodal (NFRT/atypical AVNRT). During PJRT, the AH interval is a true interval reflecting sequential activation of the atrium and His bundle over the AV node and similar to the AH interval when pacing at the TCL. In contrast, during NFRT and atypical AVNRT, the AH interval is a pseudointerval reflecting simultaneous activation of the atrium and His bundle and is, therefore, shorter than the AH interval when pacing at the TCL. The $\Delta AH$ was longer for the nodal tachycardias (NFRT/atypical AVNRT) compared with PJRT, and the AH interval was paradoxically shorter for atypical AVNRT/NF AP ($n=2$) and NFRT ($n=1$) than during sinus rhythm. A major limitation of $\Delta AH$ criteria, however, is the SN of the AV node to rapid fluctuations in autonomic tone so that comparison of AH intervals between tachycardia and pacing should be done close in time allowing for minimal change in the autonomic state of the patient. For atypical AV node–dependent long RP tachycardias, para-Hisian pacing was generally not useful because (1) retrograde FP conduction consistently preempted SP/AP conduction, (2) SP/AP often exhibited retrograde Wenckebach conduction, despite ventricular pacing at the slowest cycle length allowable by the sinus rate, and (3) an AV nodal response is not diagnostic of pure AV nodal conduction but can also be observed with a NF AP.

Nodal Pathways
The proximal insertion of all 4 nodal APs was determined to be the SP of the AV node by the ability of His-refractory VPDs to perturb the retrograde limb of the circuit during atypical AVNRT and NFRT. A SP insertion can also be identified by the ability of His-refractory VPDs to reset or terminate typical AVNRT in the antegrade limb. Various maneuvers can determine the distal insertion site of concealed nodal APs. An AP response to para-Hisian pacing/entrainment identifies a nodoventricular AP because retrograde conduction is dependent on myocardial capture. An AV nodal response...
indicates a NF AP because retrograde conduction is dependent on His-RB capture.4 Limited data suggest that manifest fusion during right ventricular entrainment of ORT using a nodal AP is specific to a nodoventricular fiber.20 Because the circuit for NFRT is contained within the specialized conduction system, ventricular fusion cannot occur with paced complexes that penetrate the excitable gap and entrain tachycardia (analogous to A VNRT). Although this is true when collision between antidromic and orthodromic wavefronts occurs in the A V node or His bundle, it is not when the collision point is in the right bundle distal to the bifurcation of the His bundle and proximal to the take-off of the NF AP. In this case, the His bundle–left bundle–ventricular axis is orthodromically activated and can fuse with paced complexes from the right ventricle.

**Limitations**

The number of patients in our collection is relatively small, and our data should be evaluated in more patients. Furthermore, 1 patient contributed 2 SVTs, which violates the requirement for independent observations. However, it is to our knowledge the only series comparing both bystander NF tachycardias and NFRT providing useful information about these rarely described tachycardias. Accurate diagnosis requires evaluating all available clues from the electrophysiologic study (eg, effect of BBB) as differentiating NFRT from atypical A VNRT/NF AP using entrainment alone can be difficult and potentially misleading in certain situations. If the refractory period of a bystander NF AP is sufficiently short to support 1:1 conduction during entrainment and conduction over the NF AP is faster than over the His-Purkinje system, the pathway for entrainment of atypical AVNRT/NF AP using entrainment alone can be difficult and potentially misleading in certain situations. If the refractory period of a bystander NF AP is sufficiently short to support 1:1 conduction during entrainment and conduction over the NF AP is faster than over the His-Purkinje system, the pathway for entrainment of atypical AVNRT/NF AP and NFRT is the same and the PPI can be short. Conversely, severe decremental conduction over a NF AP might generate long PPIs during entrainment of

![Figure 5](image1.png)

Postspacing interval–tachycardia cycle length (PPI–TCL) values for atypical atrioventricular nodal reentrant tachycardia (AVNRT; with/without a concealed, bystander nodofascicular [NF] accessory pathway) and orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia [PJRT]/NF reentrant tachycardia).

![Figure 6](image2.png)

Diagram illustrating the reentrant circuits for the 4 atypical atrioventricular (AV) node–dependent SVTs. The upper and lower portions of each circuit differ and require separate pacing maneuvers for diagnosis. A concealed nodofascicular accessory pathway bypasses the His bundle and allows access to the AV nodal reentrant tachycardia (AVNRT) circuit from the ventricle. HPS indicates His-Purkinje system; NFRT, NF, reentrant tachycardia; and PJRT, permanent form of junctional reciprocating tachycardia.

### Table 1. Electrophysiological Criteria Differentiating the 4 Atypical AV Node–Dependent Long RP SVTs

<table>
<thead>
<tr>
<th></th>
<th>Atypical AVNRT (w/wo NF AP; n=14)</th>
<th>PJRT/NFRT (n=6)</th>
<th>P Value/95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, y</td>
<td>54±19</td>
<td>42±13</td>
<td>P=0.036</td>
</tr>
<tr>
<td>Women</td>
<td>3/14 (21%)</td>
<td>5/6 (83%)</td>
<td>P=0.036</td>
</tr>
<tr>
<td>TCL</td>
<td>429 ms</td>
<td>435 ms</td>
<td>95% CI=−47.5–35.5</td>
</tr>
<tr>
<td>A-A-V pattern</td>
<td>11/14 (79%)</td>
<td>1/6 (17%)</td>
<td>P=0.036</td>
</tr>
<tr>
<td>PPI–TCL</td>
<td>176 ms</td>
<td>118 ms</td>
<td>95% CI=26.3–89.7</td>
</tr>
<tr>
<td>PPI–TCL&lt;115</td>
<td>0/14 (0%)</td>
<td>5/6 (83%)</td>
<td>P=0.001</td>
</tr>
<tr>
<td>cPPI</td>
<td>170±34 ms</td>
<td>115±69 ms</td>
<td>95% CI=21.7–88.3</td>
</tr>
<tr>
<td>cPPI&lt;110</td>
<td>0/13 (0%)*</td>
<td>4/6 (67%)</td>
<td>P=0.007</td>
</tr>
<tr>
<td>∆VA</td>
<td>160±34 ms</td>
<td>101±76 ms</td>
<td>95% CI=25.9–42.2</td>
</tr>
<tr>
<td>∆VA&lt;85</td>
<td>0/14 (0%)</td>
<td>4/6 (67%)</td>
<td>P=0.005</td>
</tr>
<tr>
<td>∆HA</td>
<td>72±40 ms</td>
<td>-1±58 ms</td>
<td>95% CI=35.6–110</td>
</tr>
<tr>
<td>∆HA&lt;0</td>
<td>0/11 (0%)</td>
<td>4/6 (67%)</td>
<td>P=0.012</td>
</tr>
<tr>
<td>NFRT/Atypical AVNRT</td>
<td>PPI</td>
<td>P Value/95% CI</td>
<td></td>
</tr>
<tr>
<td>∆AH</td>
<td>29±19 ms</td>
<td>10±17 ms</td>
<td>95% CI=3.03–35.0</td>
</tr>
</tbody>
</table>

AV indicates atioventricular; AP, accessory pathway; CI, confidence interval; cPPI, corrected postpacing interval; NF, nodofascicular; NFRT, NF reentrant tachycardia; PJRT, permanent form of junctional reciprocating tachycardia; PPI, postpacing interval; SVT, supraventricular tachycardia; and TCL, tachycardia cycle length.

* cPPI could not be calculated in 1 patient because a His bundle deflection was not observed after entrainment.
NFRT that resemble atypical AVNRT. Entrainment results, therefore, should be corroborated with the other important findings of the study. Entrainment is not possible for patients with only nonsustained tachycardia or whose tachycardia repeatedly terminates with pacing. In such situations, evaluating the response of tachycardia at the beginning of ventricular overdrive pacing can help differentiate ORT from AVNRT but does not distinguish NFRT from PJRT or AVNRT/NF AP from ORT.21,22 Atrial extrastimulation and overdrive pacing were not systematically performed during tachycardia to exclude junctional tachycardia or assess VA linking.23–25 However, because focal junctional tachycardia associated with retrograde conduction over the SP is extremely rare and none of our tachycardias exhibited nonreentrant behavior (eg, warm-up/cool-down phenomenon, initiation after a spontaneous junctional complex), we are confident of our diagnoses. In addition, the value of VA linking in long RP tachycardias is unclear because VA intervals can vary significantly during atypical ORT and AVNRT because of decremental conduction over the AP and SP, respectively. Rather, AT was excluded by classical electrophysiological criteria.

Conclusions
Diagnosing the atypical AV node–dependent long RP SVT requires separate pacing maneuvers to delineate the upper and lower limbs of the circuit. Long PPIs are common and a PPI–TCL<125 ms seems better than 115 ms for differentiating ORT (PJRT/NFRT) from atypical AVNRT. Other entrainment criteria (cPPI<110 ms, ∆VA<85 ms, and ∆AH<0 ms) are only modestly sensitive but 100% specific for ORT. Differentiating nodal tachycardias (NFRT/atypical AVNRT) from PJRT can be established by ∆AH criteria or the paradoxical finding of AH (AVNRT)<AH (NFR). His-refractory VPDs was the only maneuver to identify a bystander, concealed NF AP during atypical AVNRT.

Disclosures
None.

References


**CLINICAL PERSPECTIVE**

Atypical atrioventricular (AV) node–dependent long RP supraventricular tachycardias (SVTs) are uncommon and can be challenging to diagnose. Standard SVT criteria using pacing maneuvers in both the atrium (ΔAH criterion) and the ventricle (postspacing interval–tachycardia cycle length, corrected postspacing interval, ΔVA, and ΔHA criteria) were used to define the upper and lower circuit of the 4 AV node–dependent long RP SVTs: atypical atrioventricular nodal reentrant tachycardia (AVNRT) with and without a concealed, bystander nodofascicular (NF) accessory pathway (AP) and orthodromic reciprocating tachycardia using a concealed, slowly conducting, decremental atrioventricular (permanent form of junctional reciprocating tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia). We found that a postspacing interval–tachycardia cycle length<125 ms was better than 115 ms for differentiating orthodromic reciprocating tachycardia (permanent form of junctional reciprocating tachycardia/NF reentrant tachycardia) or NF AP (NF reentrant tachycardia).
Electrophysiological Features Differentiating the Atypical Atrioventricular Node–Dependent Long RP Supraventricular Tachycardias
Reginald T. Ho, Daniel R. Frisch, Behzad B. Pavri, Steven A. Levi and Arnold J. Greenspon

Circ Arrhythm Electrophysiol. 2013;6:597-605; originally published online April 29, 2013; doi: 10.1161/CIRCEP.113.000187
Circulation: Arrhythmia and Electrophysiology is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
Copyright © 2013 American Heart Association, Inc. All rights reserved.
Print ISSN: 1941-3149. Online ISSN: 1941-3084

The online version of this article, along with updated information and services, is located on the World Wide Web at:
http://circep.ahajournals.org/content/6/3/597

Permissions: Requests for permissions to reproduce figures, tables, or portions of articles originally published in Circulation: Arrhythmia and Electrophysiology can be obtained via RightsLink, a service of the Copyright Clearance Center, not the Editorial Office. Once the online version of the published article for which permission is being requested is located, click Request Permissions in the middle column of the Web page under Services. Further information about this process is available in the Permissions and Rights Question and Answer document.

Reprints: Information about reprints can be found online at:
http://www.lww.com/reprints

Subscriptions: Information about subscribing to Circulation: Arrhythmia and Electrophysiology is online at:
http://circep.ahajournals.org//subscriptions/