Patients With Two Types of Atrioventricular Junctional (AV Nodal) Reentrant Tachycardia

Evidence That a Common Pathway of Nodal Tissue Is Not Present Above the Reentrant Circuit

Mark A. McGuire, MB, BS, BMedSc, FRACP; Kai-Chiu Lau, MB, BS, FRCP; David C. Johnson, MB, BS, FRACS; David A. Richards, MD, FRACP; John B. Uther, MD, FRACP; and David L. Ross, MB, BS, FRACP

Background. The site of the reentrant circuit in atrioventricular (AV) junctional reentrant tachycardia has not been defined; in particular, the existence of a common pathway of AV nodal tissue above the reentrant circuit is controversial.

Methods and Results. Two types of AV junctional reentrant tachycardia were induced in each of three patients at electrophysiological study. In one type of tachycardia (anterior), the onset of atrial activity occurred from 0 to 12 msec before the onset of ventricular activation, and earliest atrial activity was recorded near the His bundle. In the second type of tachycardia (posterior), the ventriculoatrial intervals were longer (76–168 msec), and earliest atrial activity was recorded near the mouth of the coronary sinus. In individual patients, the two types of tachycardia had different cycle lengths. Posterior AV junctional reentrant tachycardia was not a fast–slow form of AV junctional reentry in at least two of the three patients. Surgical cure was attempted in two patients. In one patient, anterior AV junctional reentrant tachycardia was abolished by dissection of the anterior perinodal atrium, but posterior AV junctional reentrant tachycardia could still be induced. At reoperation 4 months later, dissection of the posterior perinodal atrium abolished posterior AV junctional reentrant tachycardia while preserving AV conduction.

Conclusion. Differences in ventriculoatrial intervals and cycle lengths and the results of selective surgery suggest that the two types of AV junctional reentrant tachycardia used different reentrant circuits. These observations imply that a common pathway of AV nodal tissue is not present above the reentrant circuit and suggest that perinodal atrium is part of these circuits. (Circulation 1991;83:1232–1246)

Atrioventricular (AV) junctional reentrant tachycardia is the most frequent form of supraventricular tachycardia. This arrhythmia is known to result from reentry in the region of the AV node, but the precise site of the reentrant circuit has not been defined.1 Dual AV junctional pathways may be the substrate of this arrhythmia, and these are thought to fuse at their lower ends in the region of the His bundle.2–4 However, it is unknown what completes the circuit at the upper end of the AV junction. Previous research has produced conflicting evidence on the latter point.5–12 Although several groups of investigators have suggested that atrial tissue completes the circuit,2,11,12 many authorities favor the presence of a common pathway of AV nodal tissue above the circuit5–7; standard diagrams used for teaching and in reviews endorse this concept.8–10 Resolution of this controversy is important for the rational design of surgical and ablative procedures for treatment of this arrhythmia.

We describe three patients in each of whom two types of AV junctional reentrant tachycardia could be induced at electrophysiological study. In one type of tachycardia (anterior), atrial activation appeared first at the anterior aspect of the AV node, whereas in the other type (posterior), the first site of atrial...
TABLE 1. Baseline Electrophysiological Parameters

<table>
<thead>
<tr>
<th>Patient</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>PA (msec)</td>
<td>56</td>
<td>40</td>
<td>44</td>
</tr>
<tr>
<td>AH (msec)</td>
<td>34</td>
<td>60</td>
<td>64</td>
</tr>
<tr>
<td>HV (msec)</td>
<td>44</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>QRSD (msec)</td>
<td>92</td>
<td>85</td>
<td>92</td>
</tr>
<tr>
<td>RA ERP (msec)</td>
<td>200</td>
<td>200</td>
<td>190</td>
</tr>
<tr>
<td>AVN ERP (msec)</td>
<td>&lt;220</td>
<td>250</td>
<td>290</td>
</tr>
<tr>
<td>VACS ERP (msec)</td>
<td>&lt;250</td>
<td>270</td>
<td>&lt;230</td>
</tr>
<tr>
<td>Dual AV pathways (antegrade)</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>ERP fast pathway (antegrade)</td>
<td>320</td>
<td>500</td>
<td>340</td>
</tr>
<tr>
<td>Dual VA pathways (retrograde)</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>ERP fast pathway (retrograde)</td>
<td>-</td>
<td>510</td>
<td>-</td>
</tr>
<tr>
<td>AV Wenckebach CL (msec)</td>
<td>340</td>
<td>300</td>
<td>370</td>
</tr>
<tr>
<td>VA Wenckebach CL (msec)</td>
<td>290</td>
<td>420</td>
<td>300</td>
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QRSD, duration of QRS complex; RA, right atrium; ERP, effective refractory period; AVN, atrioventricular node; VACS, ventriculoatrial conduction system; AV Wenckebach CL, longest cycle length at which decremental atrial pacing induced atrioventricular block; VA Wenckebach CL, longest cycle length at which decremental ventricular pacing induced block in ventriculoatrial conduction system.

activation was posterior to the node near the mouth of the coronary sinus. Our observations suggest that the posterior type of AV junctional reentry does not use a concealed septal accessory ventriculoatrial (VA) connection and is not an antidromic form of the anterior type. Furthermore, these observations argue against the presence of a common pathway of AV nodal tissue above the reentrant circuit and favor the inclusion of perinodal atrium in this circuit.

TABLE 2. Electrophysiological Variables During Tachycardia

<table>
<thead>
<tr>
<th>Electrode recording earliest atrial activation</th>
<th>A</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle length (msec)</td>
<td>244</td>
<td>368</td>
</tr>
<tr>
<td>VA interval (msec)</td>
<td>-12</td>
<td>168</td>
</tr>
<tr>
<td>AH interval (msec)</td>
<td>208</td>
<td>104</td>
</tr>
<tr>
<td>HA interval (msec)</td>
<td>36</td>
<td>264</td>
</tr>
<tr>
<td>Retrograde conduction time (msec)</td>
<td>6</td>
<td>196</td>
</tr>
<tr>
<td>Antegrade-to-retrograde conduction ratio</td>
<td>35</td>
<td>0.5</td>
</tr>
<tr>
<td>Mode of induction</td>
<td>AP</td>
<td>AP</td>
</tr>
<tr>
<td>Isoproterenol required for induction</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

A, anterior atrioventricular (AV) junctional reentrant tachycardia; P, posterior AV junctional reentrant tachycardia; VA, interval from onset of ventricular activity to onset of atrial activity by whichever electrode recorded the smallest interval; AH, interval from first rapid deflection of atrial electrogram (in lead recording His activity) to onset of His activity; HA, interval from onset of His activity to first rapid deflection of atrial electrogram (in lead recording His activity); retrograde conduction time, interval from offset of His electrogram to onset of atrial electrogram (in whichever lead recorded earliest atrial activity); antegrade-to-retrograde conduction ratio, ratio of AH interval to retrograde conduction interval; HB, His bundle electrode; PCS, proximal coronary sinus; AP, atrial pacing or extrastimuli; VP, ventricular pacing.

In patients in whom isoproterenol was required to aid induction of tachycardia, measurements were made during isoproterenol infusion.

Methods

Terminology

In 1985, we reported the results of endocardial mapping of the right atrium during AV junctional reentrant tachycardia.12 These data indicated that in most cases, earliest atrial activation occurred at the apex of the triangle of Koch (type A), but in a few patients, earliest atrial activation was found posterior to the AV node near the mouth of the coronary sinus (type B). We now use the more descriptive terms of "anterior and posterior AV junctional reentrant tachycardia" rather than "types A and B." We use the term "AV junctional reentrant tachycardia" in preference to "AV nodal reentrant tachycardia" because the exact site of reentry has not been determined.5–12

"AV junctional reentrant tachycardia" was defined as reentrant tachycardia using only nodal or nodal and atrial tissues as components of the reentrant circuit. Tachycardias using extranodal accessory VA connections were excluded from the present study. "Anterior AV junctional reentrant tachycardia" was defined as that in which atrial activity was first recorded by the His bundle catheter electrode. "Posterior AV junctional reentrant tachycardia" was defined as that in which atrial activity was first recorded by the proximal coronary sinus electrode. A1, H1, and V1 represent the atrial, His, and ventricular electrograms of the drive train beats, respectively, and A2, H2, and V2 represent the same electrograms of premature stimulated beats. "Dual antegrade junctional pathways" were defined as discontinuities in the curve when A1A2 was plotted against A1H2. "Dual retrograde AV junctional pathways" were defined as discontinuities in...
Figure 1. Two types of atrioventricular (AV) junctional reentrant tachycardia demonstrated in an individual patient (patient 1). Left page: Anterior AV junctional reentrant tachycardia. Atria are activated first from anterior aspect of AV node. Atrial activity is inscribed first by His bundle electrode, and interval from onset of ventricular activity to onset of atrial activity is −12 msec. Vertical broken line indicates onset of ventricular activity. Right page: Posterior AV junctional reentrant tachycardia. Atria are activated first from posterior aspect of AV node. Atrial activity is inscribed first by proximal coronary sinus electrode, and interval from onset of ventricular activity to onset of atrial activity is 168 msec. HRA, high right atrial lead; PCS, proximal coronary sinus lead; DCS, distal coronary sinus lead; HBE, His bundle lead; RVA, right ventricular apical lead; X, Y, Z, surface electrocardiographic leads (Frank system); A, atrial electrogram; H, His bundle electrogram; V, ventricular electrogram. Paper speed was 250 mm/sec.
FIGURE 2. Patient 2. Left page: Anterior atrioventricular (AV) junctional reentrant tachycardia. Right page: Posterior AV junctional reentrant tachycardia. Timing of atrial activity in His bundle electrogram is indicated. Small deflection at end of ventricular activity in His bundle electrogram is part of ventricular activation. Direct endocardial recordings at surgery confirmed that site of earliest atrial activation was at mouth of coronary sinus. HRA, high right atrial lead; PCS, proximal coronary sinus lead; DCS, distal coronary sinus lead; HBE, His bundle lead; RVA, right ventricular apical lead; X, Y, Z, surface electrocardiographic leads (Frank system); A, atrial electrogram; H, His bundle electrogram; V, ventricular electrogram. Paper speed was 250 mm/sec.
Figure 3A. Patient 3. Anterior atrioventricular (AV) junctional reentrant tachycardia. A short episode of AV block has occurred (asterisk) allowing clear visualization of atrial activation sequence. Note that a His bundle spike is not clearly present before the nonconducted beat, indicating that the site of block is probably in the upper His bundle or lower AV node. Atrial activity is recorded first by the His bundle electrode (HBE). Fifth and sixth beats have been conducted with a left bundle branch block pattern. Note that there is minor variation in HA interval as tachycardia “wars up,” causing atrial activity recorded by HBE to be deformed to a variable degree by overlying ventricular activity. In addition, presence of left bundle branch block in fifth and sixth beats leads to delay in onset of ventricular activity that also alters shape of local electrogram.
Figure 3B. Initiation of posterior AV junctional reentrant tachycardia by an atrial extrastimulus (S). Tachycardia commences with sudden prolongation of AH interval to 325 msec. AH interval of 325 msec is consistent with slow pathway conduction (see Figure 4), indicating that this rhythm uses this pathway for antegrade conduction. This observation is evidence that this arrhythmia is not a form of fast-slow tachycardia and is not using a reversed form of circuit used by anterior AV junctional reentrant tachycardia. HRA, high right atrial lead; PCS, proximal coronary sinus lead; DCS, distal coronary sinus lead; RVA, right ventricular apical lead; X, Y, Z, surface electrocardiographic leads (Frank system); A, atrial electrogram; H, His bundle electrogram; V, ventricular electrogram. Paper speed was 100 mm/sec.
the curve of $V_1V_2$ against $H_2A_2$. "VA interval" was defined as the interval from the onset of ventricular activity in the surface electrocardiographic leads to the onset of earliest atrial activity in any lead.

**Patients**

During the years 1985–1988, we studied 158 patients with AV junctional reentrant tachycardia in our electrophysiology laboratory. In 143 patients (91%), anterior AV junctional reentrant tachycardia alone was inducible; in 12 patients (7%), posterior AV junctional reentrant tachycardia alone was inducible; and in three patients (2%), both types of tachycardia were inducible. The latter patients are the subjects of the present study. This patient group comprised two females 15 and 34 years old (patients 1 and 2, respectively) and one man 25 years old (patient 3). No patient had structural heart disease. All patients had suffered paroxysmal episodes of narrow complex supraventricular tachycardia. The resting 12-lead electrocardiogram was normal in all patients.

**Electrophysiological Studies**

The method of electrophysiological study has been described previously. Briefly, these studies were performed in the postabsorptive state after sedation with 10 mg diazepam administered orally. Quadripolar 6F electrode catheters were placed in the upper right atrium, right ventricular apex, and coronary sinus. The coronary sinus catheter was positioned with the proximal electrode situated at the mouth of the coronary sinus. A 6F tripolar catheter (1-cm interelectrode distance) was placed across the tricuspid valve to record the His bundle potential. Signals were filtered with a bandpass of 50–1,000 Hz. Recordings were made using an eight-channel ink-jet recorder (Siemens-Elema Mingograf) at paper speeds of 100 and 250 mm/sec.

Antegrade AV node conduction was assessed by extrastimulus testing using a basic cycle length as close as possible to 600 msec. The coupling intervals of atrial extrastimuli were shortened in 20-msec decrements until atrial refractoriness. Retrograde AV node conduction was assessed in an analogous manner using ventricular stimulation. Antegrade and retrograde conduction was also assessed by pacing either the atria or ventricles at progressively faster rates until conduction block was noted.

During tachycardia, extrastimuli were delivered to the right ventricular apex every eight beats at progressively shorter intervals (decrements of 10 msec) beginning in late diastole and continuing until ventricular refractoriness or the tachycardia was terminated. Tachycardias using concealed accessory pathways were excluded using methods previously described.

**Surgical Therapy**

Surgical cure was attempted in patients 2 and 3. Details of the surgical methods have been described previously. The results of surgical therapy were assessed at electrophysiological study 6 months after the surgical procedure. The method of testing was as described above. In all patients, isoproterenol and atropine were administered in an attempt to induce tachycardia if it could not be induced in the baseline state.

**Results**

**Electrophysiological Studies**

Electrophysiological characteristics are shown in Table 1. Dual antegrade AV junctional pathways were present in all patients. Dual retrograde AV junctional pathways were demonstrated in patient 2 only. Electrophysiological parameters during tachycardia are shown in Table 2. In each patient, two types of AV junctional reentrant tachycardia were induced (Figures 1–3). Tachycardia was sustained and could be reproducibly induced in all patients. During anterior AV junctional reentrant tachycardia, the VA intervals ranged between 0 and −12 msec, and atrial activation was inscribed first at the low anterior atrial septum by the His bundle electrode catheter. During posterior AV junctional reentrant tachycardia, the VA intervals were longer (more than 70 msec), and atrial activation appeared first in the region of the mouth of the coronary sinus. In all patients, tachycardia commenced with prolongation of the AH interval. In patient 1, the longest cycle length of atrial pacing that induced AV block was longer than the cycle length of anterior AV junctional reentrant tachycardia. Presumably, this was because autonomic tone varied over the interval between the two measurements.

**Atrial activation sequence during ventricular pacing.** In patients 1 and 3, the atrial activation sequence during ventricular pacing was identical to that during anterior AV junctional reentrant tachycardia. In patient 2, the atrial activation sequence during ventricular pacing was similar to that of anterior tachycardia during fast pathway conduction and similar to that of posterior tachycardia during slow pathway conduction.

**Response to rapid ventricular pacing.** In patient 1, the VA intervals increased gradually as the pacing rate increased until, at a cycle length of 290 msec, 2:1 VA conduction was noted. In patient 2, at cycle lengths of less than 420 msec, VA conduction was rapid, and the atrial activation sequence was identical to that of anterior AV junctional reentrant tachycardia. At a cycle length of 420 msec, the VA interval lengthened, and the atrial activation sequence was similar to that of posterior AV junctional reentrant tachycardia; afterward, VA block occurred. In patient 3, the VA intervals increased gradually as the pacing rate increased, and the atrial activation sequence was similar to that of anterior AV junctional reentrant tachycardia until, at a cycle length of 300 msec, Wenckebach VA block occurred. Echoes were not induced during decremental ventricular pacing in any patient.
Evidence that "posterior atrioventricular junctional reentrant tachycardia" did not use concealed accessory ventriculoatrial connections. In all patients, ventricular extrastimuli introduced at the right ventricular apex at the time of His bundle depolarization and up to 50 msec before this did not advance subsequent atrial activation. In patient 3, episodes of 2:1 AV conduction were observed, proving that concealed accessory VA connections were not used (Figure 5). In this case, the site of AV block was above the His bundle recording site, as His spikes are not present after atrial activation in the blocked beats. AV block at this site during AV junctional tachycardia has been described previously.12 Thus, in patients 1 and 2, it is unlikely that concealed accessory pathways formed part of the reentrant circuit,13,14,16–19 whereas in patient 3 this is beyond doubt.

Evidence that "posterior atrioventricular junctional reentrant tachycardia" was not due to intra-atrial reentry. In patient 1, ventricular extrastimuli that did not advance subsequent atrial activation nevertheless terminated tachycardia in the next cycle, indicating that this tachycardia was not a result of intra-atrial reentry. This mode of delayed termination of AV junctional reentrant tachycardia has been described previously.20 In patient 2, during posterior tachycardia, ventricular extrastimuli introduced at the right ventricular apex more than 52 msec before the expected His bundle deflection delayed subsequent atrial activation by 8 msec with the same activation sequence as that of the tachycardia, also indicating that the tachycardia was not a result of intra-atrial reentry. In patient 3, during posterior AV junctional reentrant tachycardia, ventricular extrastimuli intro-duced at the right ventricular apex more than 80 msec before the expected His bundle deflection advanced atrial activation with the same activation sequence as that of the tachycardia, indicating that the tachycardia was unlikely to be a result of intra-atrial reentry (Figure 6).

Surgical Therapy

Surgery was performed in patients 2 and 3. In patient 2, surgical cure was attempted early in our experience of this procedure. At that time, we were uncertain whether posterior AV junctional reentrant tachycardia was an antidromic form of the anterior type. We were also concerned that dissection of both the anterior and posterior inputs of the AV node might cause complete heart block. Accordingly, only the anterior inputs to the node were dissected. In this patient, posterior AV junctional reentrant tachycardia recurred 13 weeks after surgery. At repeat electrophysiological study, posterior AV junctional reentrant tachycardia could be induced, but anterior AV junctional reentrant tachycardia could not. Dual antegrade AV junctional pathways were present, and retrograde conduction was possible. A second surgical procedure was undertaken in which the posterior inputs to the AV node were dissected. At electrophysiological study performed 6 months after the second surgical procedure, no arrhythmias were inducible, and the patient has experienced no clinical recurrence in 26 months of follow-up. Retrograde conduction was no longer possible, and only fast pathway conduction was present in the antegrade direction.

In patient 3, we attempted to cure both types of AV junctional reentrant tachycardia at one procedure—both the anterior and posterior inputs to the AV node were dissected. In this patient, palpitations recurred 12 weeks after the procedure, and at repeat electrophysiological study 1 month later, anterior (but not posterior) AV junctional reentrant tachycardia could be induced. Retrograde conduction was possible, but in the antegrade direction only the slow pathway remained intact.

Discussion

The occurrence of two types of AV junctional reentrant tachycardia in individuals is rare and occurred in only 2% of the 158 patients with AV junctional reentry studied in our laboratory in 1985–1988. Different sequences of atrial activation during two types of AV junctional reentrant tachycardia in the same patient argue against the presence of a common pathway of AV nodal tissue above the site of reentry. If such a pathway were present, it would be expected that all arrhythmias arising in the AV node would have the same atrial activation sequence. Of course, multiple atrial exits above a common pathway of AV nodal tissue could be present, but if this were so, it is unlikely that one exit would be consistently favored over another during the different
**Figure 5.** Posterior type of atrioventricular (AV) junctional reentrant tachycardia (patient 3). Atropine was administered during tachycardia, resulting in a decrease in atrial cycle length and 2:1 AV conduction. This is evidence that this rhythm does not use a concealed accessory ventriculoatrial connection. Note that a His bundle spike is not clearly present before the nonconducted beats, indicating that the site of block is probably in the upper His bundle or lower AV node. This is similar to the situation seen in this patient during anterior AV junctional reentrant tachycardia (see Figure 3). Block in the lower AV node in AV junctional reentrant tachycardia has been described (see text). HRA, high right atrial lead; PCS, proximal coronary sinus lead; DCS, distal coronary sinus lead; HBE, His bundle lead; RVA, right ventricular apical lead; X, Y, Z, surface electrocardiographic leads (Frank system); A, atrial electrogram; H, His bundle electrogram; V, ventricular electrogram. Paper speed was 100 mm/sec.
Figure 6. Posterior type of atrioventricular (AV) junctional reentrant tachycardia (patient 3). A ventricular extrastimulus (S) delivered to right ventricular apex early in diastole advances subsequent atrial activation with the same sequence as tachycardia. This observation would be inconsistent with intra-atrial reentry except in the unlikely event that the reentrant circuit was situated at the exit of the AV node. Numerals refer to interatrial interval (msec). Note that variation in cycle length is present; nevertheless, an interatrial interval of 424 msec is clearly outside range of spontaneous variation. HRA, high right atrial lead; PCS, proximal coronary sinus lead; DCS, distal coronary sinus lead; HBE, His bundle lead; RVA, right ventricular apical lead; X, Y, Z, surface electrocardiographic leads (Frank system); A, atrial electrogram; H, His bundle electrogram; V, ventricular electrogram. Paper speed was 250 mm/sec.
types of tachycardia if both types of tachycardia arose wholly within the AV node.

The short VA intervals observed during anterior tachycardia argue that this arrhythmia results from AV junctional (nodal) reentry, but the longer VA intervals found in posterior tachycardia necessitate that this arrhythmia be distinguished from tachycardias using concealed septal accessory VA connections or those resulting from intra-atrial reentry.

Evidence That "Posterior Atrioventricular Junctional Reentrant Tachycardia" Does Not Use a Concealed Accessory Ventriculoatrial Connection

Clearly, the example of tachycardia found in patient 3 cannot use an extranodal accessory AV connection because 2:1 AV conduction was observed. In patients 1 and 2, evidence against this mechanism is provided by the results of the ventricular extrastimulus test. This method of identifying tachycardias using accessory VA connections is a development of observations made by Wellens and Durrer,16 Durrer et al.,17 Coumel et al.,18 and Zipes et al.19 The test is performed by stimulating the ventricles during tachycardia while the His bundle is refractory. If the subsequent atrial beat is advanced, it follows that the ventricular extrastimulus can have been conducted to the atria only via an extranodal pathway. Failure to preexcite the atria indicates that an accessory pathway is not present or that the accessory pathway is relatively far from the site of premature stimulation. Our group extended this concept by examining the effect of ventricular extrastimuli delivered in the 50 msec before His bundle depolarization and found that in all cases of AV junctional reentrant tachycardia, ventricular extrastimuli delivered coincident with the His potential and up to 50 msec before this did not advance subsequent atrial activation.14 Conversely, in cases of tachycardia using septal accessory pathways, the subsequent atrial beat was always advanced when the ventricular extrastimulus was delivered less than 50 msec before His bundle depolarization. These results are consistent with theoretical considerations.13,14 Using similar techniques, Miles and coworkers21 devised a preexcitation index based on the results of the extrastimulus test and found this test to be a reliable guide to the differentiation of the two forms of tachycardia.21 Thus, it appears unlikely that the reentrant circuit in our cases of posterior AV junctional reentrant tachycardia used an accessory VA connection.

Although we demonstrated that posterior AV junctional tachycardia does not use the common type of concealed accessory VA connection, in patient 1 and 2 we cannot exclude the possibility that this rhythm uses a "long conduction time" VA connection of the type used in "permanent" tachycardias.18 These pathways have the property of decremental conduction.22 Nevertheless, several features lead us to believe that posterior tachycardia does not use such a pathway. First, in nearly all previously reported cases of this type of tachycardia, the tachycar-
ent study appears similar to slow–fast tachycardia, but several points lead us to believe that two of our cases of posterior tachycardia are not examples of fast–slow tachycardia and thus are not using a reversed (i.e., antidromic) reentrant circuit. First, in previously described cases of fast–slow tachycardias, the AH-to-HA ratio was less than 1, indicating that retrograde conduction was slower than antegrade conduction; however, in patients 2 and 3 of the present study, the ratio of antegrade to retrograde conduction time is more than 1, indicating that retrograde conduction is faster than antegrade conduction (see Table 2). Second, in patient 3, an atrial extrastimulus induced tachycardia after sudden prolongation of the AH interval (Figure 3, lower panel). The magnitude of the AH interval was consistent with conduction via the slow pathway in the antegrade direction (Figure 4), whereas fast–slow tachycardia uses the fast pathway for antegrade conduction. Finally, patient 2 initially underwent selective surgical dissection of the anterior atrial connections of the AV node, which cured only the anterior AV junctional reentrant tachycardia, and posterior tachycardia remained inducible at electrophysiological study 6 months later. In patient 3, posterior but not anterior AV junctional reentrant tachycardia was abolished by surgery. Selective cure of one type of tachycardia is unlikely if both types of tachycardia used the same reentrant circuit. Thus, it is probable that posterior AV junctional reentrant tachycardia uses a reentrant circuit different than that used by the anterior type and is not simply a “reversed” or antidromic form.

Exits From the Atrioventricular Node

Dual sites of exit from the AV node have been demonstrated previously. Sung et al. demonstrated that during ventricular pacing in patients with dual retrograde AV nodal pathways, conduction via the slow pathway first excited the atrium near the mouth of the coronary sinus, whereas conduction via the fast AV nodal pathway activated the atrium from the low anterior septal region. AV junctional reentrant tachycardia, however, was not induced in these patients. These two atrial exits appear similar to those found during tachycardia in our patients.

Proposed Models of the Reentrant Circuit

Our observations suggest that a common pathway of AV nodal tissue does not form a single exit to the atrium from the site of reentry. Instead, multiple exits must exist. Thus, the reentrant circuit is unlikely to exist as depicted in Figure 7A. The posterior and anterior types of AV junctional reentrant tachycardia, when occurring in the same patient, have different atrial activation sequences, VA intervals, and cycle lengths—suggesting that the two forms of tachycardia use different circuits. Although the different atrial activation sequences may be explained by intranodal circuits with different atrial exits (see Fig-

![Diagram of AV Junctional Reentrant Tachycardia](image-url)
ures 7B and 7C), the different VA intervals and cycle lengths are more easily explained if it is assumed that perinodal atrium forms part of the circuit (see Figure 7D). This indicates that the slow pathway can be used for antegrade conduction during both anterior and posterior types of AV junctional reentrant tachycardia, as demonstrated in patient 3. Note that in this model, the retrograde limb of the circuit of posterior tachycardia traverses more nodal tissue than in the anterior type, which explains the longer VA intervals found in the former.

Conclusions

At least two types of AV junctional reentry exist. Our findings indicate that an upper common pathway of nodal tissue is not present above the reentrant circuit in AV junctional reentrant tachycardia. Furthermore, it is likely that the reentrant circuits use perinodal atrial tissue. Anterior and posterior AV junctional reentrant tachycardias use different circuits and are not reversed forms of each other. We note that this situation may not apply to all cases of this arrhythmia and that wholly intranodal reentry remains a possible mechanism of this arrhythmia.

References

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Key Words • supraventricular tachycardia • electrophysiological study
Patients with two types of atrioventricular junctional (AV nodal) reentrant tachycardia. Evidence that a common pathway of nodal tissue is not present above the reentrant circuit.

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