Recurrence of Atrial Tachyarrhythmia During the Second Month of the Blanking Period Is Associated With More Extensive Pulmonary Vein Reconnection at Repeat Electrophysiology Study

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Background—Current guidelines recommend a 3-month blanking period after pulmonary vein isolation (PVI) for atrial fibrillation (AF). Early recurrence of atrial tachyarrhythmia (ERAT) may be due to transient proarrhythmic factors. However, studies have suggested that these factors resolve by 1 month. PV reconnection (PVrc) is strongly associated with postblanking AT recurrence in paroxysmal atrial fibrillation. We hypothesized that ERAT occurring beyond 4 weeks after PVI is associated with PVrc at repeat electrophysiology study.

Methods and Results—Forty patients with paroxysmal atrial fibrillation underwent mandatory repeat electrophysiology study 2 months after PVI, regardless of symptoms, to document the number of reconnected PVs. Antiarrhythmic drugs, including β-blockers, were discontinued 4 weeks after PVI. Patients were instructed to record a 30-second ECG everyday between the 2 procedures using a portable monitor, with additional recordings for symptoms. ERAT was defined as ≥30 seconds of AT. Patients recorded a total of 3293 ECGs. Four (10%) patients had ERAT in the first 4 weeks (M1) only, 2 (5%) in month 2 (M2) only, and 11 (28%) in both. PVrc of 1 PV was identified in 12 (30%) patients and of >1 PV in 13 (32%) patients. ERAT in M2 was associated with PVrc, whereas M1 was not (11/13 [85%] versus 0/4 [0%; P=0.006]. M2 ERAT was strongly associated with PVrc of >1 PV (10/13 [77%] versus 3/27 [11%] without M2 ERAT; P<0.0001).

Conclusions—ERAT occurring beyond 4 weeks after PVI is associated with PVrc and particularly of PVrc of >1 PV. ERAT confined to M1 is unrelated to underlying PVrc. The relationship between ERAT beyond 4 weeks after PVI and postblanking AT recurrence merits further investigation. (Circ Arrhythm Electrophysiol. 2015;8:846-852. DOI: 10.1161/CIRCEP.115.003095.)

Key Words: atrial fibrillation ▪ catheter ablation ▪ electrophysiology ▪ pulmonary veins

Current international guidelines recommend a 3-month blanking period after pulmonary vein (PV) isolation (PVI) for atrial fibrillation (AF). Early recurrence of atrial tachyarrhythmia (ERAT) during this period is thought not to be indicative of longer-term AF recurrence in a significant proportion of cases, and therefore, repeat intervention is not recommended. Suggested causes for ERAT include proarrhythmia related to postablation inflammation or temporary autonomic imbalance or the time taken for the lesion set deployed to mature. Although PV reconnection (PVrc) is clearly established as being associated with long-term arrhythmia recurrence in paroxysmal AF, these transient factors would not be expected to lead to late AF recurrence. However, the time point at which these transient causes of ERAT give way to arrhythmia episodes related to PVrc has not been clearly established. Recent biochemical data have shown that the postablation inflammatory phase is usually limited to the first month after PVI and a study of heart rate variability changes has also demonstrated the spontaneous recovery of transient autonomic dysfunction by 1 month. Histological studies have described the formation of well-demarcated homogenous lesions by 1 week after ablation. Previous studies have shown ERAT to be a strong predictor of AF recurrence beyond 3 months, with later onset, in the second and third months after ablation, being more predictive.

For these reasons, we hypothesized that ERAT occurring beyond 4 weeks is associated with PVrc. We sought to test this hypothesis by studying the relationship between ERAT and PVrc at mandatory repeat electrophysiology study 2 months after PVI.
WHAT IS KNOWN

- At present, international guidelines recommend a 3-month blanking period after pulmonary vein isolation (PVI), as early recurrence of arrhythmia may not signify longer-term treatment failure because of transient proarrhythmic factors.
- The vast majority of postblanking period atrial tachyarrhythmia recurrence in patients with paroxysmal atrial fibrillation is because of PV reconnection.

WHAT THE STUDY ADDS

- Arrhythmia recurrence beginning or continuing beyond 4 weeks post-PVI is associated with PV reconnection at repeat EP study, whereas recurrence confined to the first 4 weeks is not.
- In particular, arrhythmia recurrence beyond 4 weeks is strongly associated with reconnection of 2 or more PVS, and therefore such recurrence may potentially be of clinical relevance.

Methods

Patient Population

Forty consecutive patients undergoing elective radiofrequency catheter ablation for paroxysmal AF were prospectively studied with protocol-mandated repeat electrophysiology study at 2 months, regardless of symptoms, and daily ECG recordings in the intervening period. Inclusion criteria were a current pattern of paroxysmal AF (defined as ECG proven episodes of AF which are self-limiting and last <7 days on each occasion or which were cardioverted electrically or pharmacologically <48 hours from onset) and aged >18 years. Exclusion criteria were as follows: previous ablation procedure for AF, previous prosthetic mitral valve replacement, severe structural cardiac abnormality (significant congenital heart disease likely to affect cardiac hemodynamics, including atrial septal defect with a significant shunt), known infiltrative cardiomyopathy, severe left ventricular systolic dysfunction (ejection fraction, <35%), and pregnancy. All patients provided written informed consent, and the study was approved by the United Kingdom National Research Ethics Service.

Initial PVI Procedure

Patients taking amiodarone had this stopped a minimum of 2 months before their PVI procedure; where possible, it was replaced with an alternative antiarrhythmic drug. All other antiarrhythmic drugs were stopped after 4 weeks. β-Blockers and rate-limiting calcium-channel blockers were also started and, unless required for another clinical indication, were also stopped after 4 weeks. Patients not taking any cardiac rhythm medications before the procedure were not newly prescribed therapy after the procedure. Patients were provided with a direct telephone number to contact if they encountered problems following PVI, particularly symptoms suggestive of AF recurrence, so as to avoid inadvertent restarting of antiarrhythmic drugs by accessing other medical advice. Reinitiation of therapy was permitted in the event of symptomatic documented recurrences of AT after cessation of antiarrhythmic medication at 4 weeks.

Monitoring for ERAT

All patients were provided with a validated handheld ECG monitoring device (Omron HCG-801-E, Omron Healthcare, Kyoto, Japan) ≈1 week before their initial PVI procedure. Patients were taught how to use this device and were instructed to self-record a 30-second ECG each day until the repeat electrophysiology study, with additional recordings whenever they experienced symptoms, however minor. Recordings were made with a nonphotoelectric paper recording oscilloscope (VisiTag, Biosense Webster) was used. VisiTag settings were as follows: catheter position stability: minimum time, 10 s; maximum range, 2 mm and force over time: time, 30%; minimum force, 5 g; lesion tag size: 2 mm. Acute PVI was confirmed by demonstrating entry and exit block with a 20-pole circular mapping catheter (Lasso NAV Eco, Biosense Webster) placed sequentially in each of the PVS. On-going PVI was confirmed a minimum of 20 minutes after isolation of that ipsilateral PV pair, with intravenous adenosine administered to unmask sites of dormant conduction. Further ablation was performed at sites of overt or unmasked reconnection to reisolate the PVS. AF that persisted after PVI was terminated with electric cardioversion or administration of intravenous flecainide. No additional ablation to create left atrial linear lesions or of complex fractionated atrial electrograms was performed. No attempt was made to look for extra-PV triggers.

Postprocedural Antiarrhythmic Drug Therapy

For patients taking antiarrhythmic medications before the procedure, these (other than amiodarone) were restarted after the procedure and were stopped after 4 weeks. β-Blockers and rate-limiting calcium-channel blockers were also restarted and, unless required for another clinical indication, were also stopped after 4 weeks. Patients not taking any cardiac rhythm medications before the procedure were not newly prescribed therapy after the procedure. Patients were provided with a direct telephone number to contact if they encountered problems following PVI, particularly symptoms suggestive of AF recurrence, so as to avoid inadvertent restarting of antiarrhythmic drugs by accessing other medical advice. Reinitiation of therapy was permitted in the event of symptomatic documented recurrences of AT after cessation of antiarrhythmic medication at 4 weeks.

Repeat Electrophysiology Procedure

Repeat electrophysiology study was performed 2 months after the initial PVI procedure in all cases. Any antiarrhythmic medications restarted for symptomatic documented AT recurrences beyond 4 weeks after PVI were stopped again 5 days before the repeat study. This was performed in the same way as outlined for the initial procedure. Each PV was assessed for reisolation with a 20-pole circular mapping catheter. The operator was blinded to the presence and timing of any ERAT. All identified sites of reconnection were reablated to reisolate the PV(s), regardless of the presence or absence of ERAT.
Statistical Analysis
Continuous variables are expressed as mean and SD or median and quartiles (25th to 75th percentiles) where appropriate. Student t test or the Mann–Whitney U test was used for unpaired group comparison. Categorical variables are presented as frequency or percentage and were compared by χ² or Fisher exact test. All tests were 2-sided, and P<0.05 was considered statistically significant. All statistical analysis was performed using SPSS (version 22, IBM Corp, Armonk, NY).

Results
Demographic information for the 40 study participants is provided in Table 1. Twenty-three (58%) patients were men, the mean age was 58±11 years, and the mean left atrial diameter was 39±4 mm. The mean procedure time for initial PVI procedures was 164±34 minutes, with a mean ablation time of 43.5±9.1 minutes and a median fluoroscopy time of 10.8 (8.1–15.6) minutes. Acute PVRc was identified in 20 (50%) patients, affecting 24 (15%) PVs (spontaneous reconnection in 12 PVs and adenosine-mediated in 12). All were successfully treated with further radiofrequency application.

One major complication (right phrenic nerve palsy) occurred after the initial PVI procedures, giving a complication rate of 2.5%. There were no complications related to the repeat electrophysiology procedures.

Twenty-two (55%) patients were treated with an antiarrhythmic drug at the time of their initial PVI: flecainide in combination with a rate-limiting agent in 12 (30%), flecainide monotherapy in 6 (15%), sotalol in 3 (8%), and dronedarone with a β-blocker in 1 (2%). β-Blocker monotherapy was used in 16 (40%) patients and a rate-limiting calcium channel-blocker as a sole agent in 1 (2%). One (2%) patient was not taking any cardiac rhythm medications. Antiarrhythmic drug therapy was continued during month 1 in 19 of 22 (86%) cases, with β-blocker monotherapy continued in 14 of 16 (88%) patients and verapamil monotherapy continued in 1 patient taking this before PV. All were discontinued after 4 weeks as per trial protocol. Antiarrhythmic drugs needed to be restarted in 6 patients (in combination with a β-blocker in 4) in month 2 because of recurrent ERAT, with a β-blocker or calcium-channel blocker alone restarted in a further 3 patients.

Table 1. Patient Demographics for the Total Cohort of Subjects and for Those With and Without ERAT

<table>
<thead>
<tr>
<th></th>
<th>Total Cohort, n=40</th>
<th>ERAT, n=17</th>
<th>No ERAT, n=23</th>
<th>P Value</th>
</tr>
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<tbody>
<tr>
<td>Age, y</td>
<td>58±11</td>
<td>58±13</td>
<td>58±11</td>
<td>0.945</td>
</tr>
<tr>
<td>Men, n (%)</td>
<td>23 (58)</td>
<td>7 (41)</td>
<td>16 (70)</td>
<td>0.108</td>
</tr>
<tr>
<td>LA diameter, mm</td>
<td>39±4</td>
<td>38±5</td>
<td>40±4</td>
<td>0.057</td>
</tr>
<tr>
<td>Ejection fraction, %</td>
<td>40 (100)</td>
<td>17 (100)</td>
<td>23 (100)</td>
<td>...</td>
</tr>
<tr>
<td>Hypertension, n (%)</td>
<td>14 (35)</td>
<td>7 (41)</td>
<td>7 (30)</td>
<td>0.521</td>
</tr>
<tr>
<td>IHD, n (%)</td>
<td>2 (5)</td>
<td>0 (0)</td>
<td>2 (9)</td>
<td>0.499</td>
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<td>OSA, n (%)</td>
<td>3 (8)</td>
<td>2 (12)</td>
<td>1 (4)</td>
<td>0.565</td>
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<tr>
<td>CVA, n (%)</td>
<td>1 (2)</td>
<td>1 (6)</td>
<td>0 (0)</td>
<td>0.425</td>
</tr>
<tr>
<td>DM, n (%)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>...</td>
</tr>
<tr>
<td>Antiarrhythmic drugs (%)</td>
<td>22 (55)</td>
<td>10 (59)</td>
<td>12 (52)</td>
<td>0.755</td>
</tr>
<tr>
<td>Flecainide (%)</td>
<td>18 (45)</td>
<td>8 (47)</td>
<td>10 (43)</td>
<td></td>
</tr>
<tr>
<td>Sotalol (%)</td>
<td>3 (8)</td>
<td>2 (12)</td>
<td>1 (4)</td>
<td></td>
</tr>
<tr>
<td>Dronedarone (%)</td>
<td>1 (2)</td>
<td>0 (0)</td>
<td>1 (4)</td>
<td></td>
</tr>
<tr>
<td>β-Blockers (%)</td>
<td>28 (70)</td>
<td>13 (76)</td>
<td>15 (65)</td>
<td>0.505</td>
</tr>
<tr>
<td>Calcium-channel blockers (%)</td>
<td>2 (5)</td>
<td>1 (6)</td>
<td>1 (4)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>ACE-I/ARB (%)</td>
<td>11 (28)</td>
<td>5 (29)</td>
<td>6 (26)</td>
<td>&gt;0.999</td>
</tr>
<tr>
<td>Anticoagulation (%)</td>
<td>22 (55)</td>
<td>12 (71)</td>
<td>10 (43)</td>
<td>0.116</td>
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<tr>
<td>Warfarin (%)</td>
<td>13 (32)</td>
<td>6 (35)</td>
<td>7 (30)</td>
<td></td>
</tr>
<tr>
<td>NOAC (%)</td>
<td>9 (22)</td>
<td>6 (35)</td>
<td>3 (13)</td>
<td></td>
</tr>
<tr>
<td>Procedure time, min</td>
<td>164±34</td>
<td>157±32</td>
<td>170±36</td>
<td>0.230</td>
</tr>
<tr>
<td>Ablation time, min</td>
<td>43.5±9.1</td>
<td>43.7±10.1</td>
<td>43.3±8.6</td>
<td>0.893</td>
</tr>
<tr>
<td>Fluoroscopy time, min</td>
<td>10.8 (8.1–15.6)</td>
<td>9.9 (8.3–12.4)</td>
<td>11.8 (7.8–19.7)</td>
<td>0.277</td>
</tr>
<tr>
<td>General anesthesia, n (%)</td>
<td>31 (78)</td>
<td>11 (65)</td>
<td>20 (87)</td>
<td>0.134</td>
</tr>
<tr>
<td>Interval between procedures, d</td>
<td>62±6</td>
<td>61±5</td>
<td>62±6</td>
<td>0.258</td>
</tr>
</tbody>
</table>

ACE-I indicates angiotensin-converting enzyme inhibitor; ARB, angiotensin receptor blocker; CVA, cerebrovascular accident; DM, diabetes mellitus; ERAT, early recurrence of atrial tachyarrhythmia; IHD, ischemic heart disease; LA, left atrial; NOAC, novel oral anticoagulant; and OSA, obstructive sleep apnea.

Portable ECG Monitor Recordings and ERAT
Patients recorded a total of 3348 ECG recordings between their initial PVI procedure and repeat electrophysiology study. The quality of the ECG recordings was good enough to be interpretable in 3293 (98%): 1507 recordings in month 1 (median 32 [Q1–Q3, 28–41] ECGs per patient) and 1786 in month 2 (38 [30–50] ECGs per patient). The remaining 55 (2%) recordings, from 15 (38%) patients, were affected by artifact and were excluded from analysis.

ERAT was documented in a total of 17 (42%) patients. Demographic details for patients with and without ERAT are given in Table 1. There were no significant differences between the 2 groups. Four (10%) patients had ERAT only in month 1, with no further episodes beyond this. Two (5%) patients had ERAT in month 2 only, and 11 (28%) patients experienced ERAT in both month 1 and month 2. The 15 patients with month 1 ERAT had this recorded on 3 (2–6) separate days each, with the highest number of separate days being 11. The 13 patients with month 2 ERAT had this documented on 4 (2–6) separate days each, with the highest number being 12 days. These data are presented graphically in Figure 1.

PVr at Repeat Electrophysiology Study
No patients withdrew from the study or were lost to follow-up, and all 40 patients underwent repeat electrophysiology study. The mean interval between the initial PVI procedure and repeat electrophysiology study was 62±6 days. PVr was identified in 25 (62%) patients at repeat electrophysiology study, affecting a total of 41 (26%) PVs. Twelve (30%) patients had reconnection of 1 PV, and 13 (32%) had reconnection of ≥2 PVs. The distribution of reconnected PVs was as follows: left superior 6, left inferior 14, right superior 8, and right inferior 13. Demographic data for patients with and without PVr are shown in Table 2. All reconnected PVs in the
25 patients with PVrc were successfully reablated to achieve PVI, requiring a median of 5.1 (3.6–9.6) minutes of ablation.

Relationship Between ERAT and PVrc
ERAT either starting or continuing in month 2 was strongly associated with PVrc, whereas ERAT limited to month 1 (in the context of continued treatment with antiarrhythmic drugs) was not (11 of 13, 85% versus 0 of 4, 0%; \( P=0.006 \)). However, if no distinction was made on the time of ERAT (month 1 or 2), then no relationship with PVrc was seen (11 of 17, 65% with ERAT versus 14 of 23, 61% without ERAT; \( P>0.999 \)). There was no discernible relationship between the actual PV(s) reconnected (eg, left superior PV or right superior PV) and ERAT.

Relationship Between ERAT and Extensive PVrc
Extensive PVrc was defined as electric reconnection of \( \geq 2 \) PVs, a finding identified in 13 (32%) patients. The number of reconnected PVs for patients with and without ERAT in month 2 is shown in Figure 2. The presence of ERAT in month 2 was found to be strongly associated with extensive PVrc when compared with its absence (10 of 13, 77% versus 3 of 27, 11%; \( P<0.0001 \)). For predicting extensive PVrc, ERAT in month 2 had a sensitivity of 77%, specificity of 89%, positive-predictive value of 77%, and negative predictive value of 89%.

Discussion

Main Findings
Current guidelines advocate a blanking period after PVI so as to prevent unnecessary repeat procedures for ERAT that may be because of transient proarrhythmic factors. However, it is equally important to identify patients whose ERAT within the blanking period is secondary to PVrc so that these patients can be offered timely reintervention. The main findings of this study are that ERAT confined to the first 4 weeks after PVI (in the context of continued treatment with antiarrhythmic drugs) is not associated with PVrc at repeat electrophysiology study, whereas ERAT beyond 4 weeks is associated with PVrc and, in particular, is strongly associated with more extensive reconnection affecting >1 PV.

Previous Investigations of ERAT and Late Recurrence
Previous studies have shown that a significantly greater proportion of patients with ERAT in the first 3 months after PVI went on to have later recurrence compared with those without ERAT.\(^ {15-20} \) The main concern with taking ERAT to signify later recurrence has been the poor positive-predictive value of this finding, with up to 60% of patients with ERAT not experiencing further AT recurrence during postblanking period follow-up.\(^ {1,3} \) However, given that some early episodes of AT after PVI are likely to be related to transient factors, including postablation inflammation, temporary autonomic imbalance, or the time-course of lesion development,\(^ {4,8} \) this is to be expected. The primary issue, therefore, is not whether the blanking period should exist at all but rather how long it should be.

Duration of Transient Factors Promoting Arrhythmia After PVI
Studies have been performed looking at the time-course of each of the transient factors suggested to promote ERAT without conferring a higher risk of later recurrence. A recent study of biochemical markers demonstrated that a variety of markers of inflammation (high-sensitivity C-reactive protein, white-cell count, and neutrophil count), myocardial injury (Troponin T, creatinine kinase, and creatinine kinase-MB) and prothrombotic state (fibrinogen and D-dimer) are elevated in the days immediately after PVI, but all had returned to baseline by 30 days.\(^ {12} \) Notably, the extent of release of inflammatory markers
was related to ERAT but not to recurrence beyond the blanking period.

The autonomic nervous system is also known to be affected by PVI and has even been mooted as a potential ablation target. Hsieh et al. examined heart rate variability changes after PVI and demonstrated significant autonomic dysfunction at 1 week, with spontaneous recovery by 1 month. Finally, previous studies of the histological characteristics of radiofrequency ablation lesions have described the formation of well-demarcated, homogenous lesions by 1 week after ablation.

The overall implication from all of these studies is that transient factors promoting ERAT in the immediate postablation period resolve by 1 month.

Timing of ERAT Within the Blanking Period

Although several studies have examined the overall relationship between ERAT and later AT recurrence, relatively few have explored the relevance of the timing of these occurrences within the blanking period. One study that did do this, by Themistoclasik et al., included 1298 patients undergoing PVI and classified patients with ERAT by the month of the first occurrence. The proportion of patients going on to have postblanking period recurrences was 44% if the first episode of ERAT was in month 1, 69% if in month 2, and 98% if in month 3, indicating a high likelihood of later recurrence if ERAT began in month 2 or 3. A further study, by Bertaglia et al., found that the rate of late recurrence was significantly higher in those with a first recurrence in month 2 or 3 (80%) compared with first ERAT in month 1 (56.7%). As with the study by Themistoclasik et al., the main focus was on the timing of the first recurrence rather than the time period in which ERAT episodes persisted. As it is entirely conceivable that an individual might have ERAT related to transient proarrhythmic factors in the first month after ablation followed by ERAT related to PVrc in month 2 onwards, the timing of the last episode of ERAT would seem to be more valuable than that of the first episode. Added to this is the fact that the incidence of first AT recurrences is known to be the highest in the first month, with diminishing levels in months 2 and 3, making analysis of outcomes for these small numbers of patients difficult.

With this in mind, we reanalyzed the data of Bertaglia et al. and confirmed that their results mirrored those of our study. In their cohort, 29 patients had on-going ERAT in months 2 to 3 having had their first episode in month 1, and 5 patients had their first ERAT episode in months 2 to 3. Of these 34 patients with ERAT in months 2 to 3 (regardless of the timing of the first episode), 30 (88%) went on to have AT recurrence beyond the blanking period, compared with 11 of 109 (10%) patients without month 2 to 3 ERAT (P<0.0001). In our study, 77% of patients with ERAT in month 2 were found to have PVrc of >1 PV compared with 11% of those without month 2 ERAT. This reanalysis of the data of Bertaglia et al., together with the findings of our study, suggests that AT recurrences in month 2 onwards are clinically relevant. In contrast, however, a study by Joshi et al. using external loop recorders for automatic detection of AF recurrences in the first 3 months after PVI (divided into 2-week time periods) did not show...
AF recurrence in each 2-week period to be predictive of postblanking AF recurrence up to 12 months after PVI in a multivariable model. However, specific data on the proportion of patients with AF recurrence in each 2-week period who went on to have postblanking AF were not presented and, therefore, cannot be analyzed further.

**Clinical Relevance of Reconnection of >1 PV**

In our study, ERAT in month 2 after PVI was specifically found to be associated with reconnection of >1 PV. Previous studies have shown a relationship between this degree of PVrc and postblanking period AT recurrence. Verma et al. assessed PVrc in 107 patients after PVI: 26 without AF recurrence (group 1), 37 with AF recurrence controlled by antiarrhythmic medication (group 2), and 44 with AF recurrence which could not be medically controlled (group 3). Sixty-one patients had reconnection of >1 PV, and all had had AF recurrence (group 2 or 3). Conversely, none of the patients without recurrence in that study (group 1) had reconnection of >1 PV. For this reason, more extensive PVrc seems to be of clinical relevance in terms of the on-going risk of AT recurrence.

Statistically, reconnection of >1 PV greatly increases the likelihood of an arrhythmogenic PV reconnecting to the atria. For example, if only 1 of 4 PVs is arrhythmogenic and only 1 PV reconnects, the likelihood of it being the arrhythmogenic PV is 1 in 4 (25%), whereas if 2 PVs reconnect, this risk is increased to 3 in 6 (50%). If there are 2 arrhythmogenic veins, reconnection of 2 PVs confers a 5 in 6 (83%) risk of an arrhythmogenic PV reconnecting compared with a 2 in 4 (50%) risk if only 1 PV reconnects. Clearly, however, the combination of factors that eventually lead to clinical AF recurrence is far more complex than these simple proportions.

**Limitations**

The sample size of this study was small because of the invasive nature of the assessment for PVrc, which limits the strength of the observations. We specifically sought to determine the relationship between ERAT and PVrc, and therefore, long-term follow-up data on AF recurrence are not presented. Although these data could have been obtained from this cohort of patients had we not reisolated PVrc identified at repeat electrophysiology study, we felt it reasonable and in the patients’ best interests to do so given that AF recurrence in paroxysmal AF is known to be associated with PVrc in the overwhelming majority of cases. Given the well-established role of the PVs in paroxysmal AF, we did not specifically look to identify extra-PV triggers during the electrophysiology studies. We continued antiarrhythmic medications for 4 weeks after PVI. This may have affected the incidence of ERAT in month 1, and it may have been preferable to discontinue all antiarrhythmic medications following PVI. However, given the existing data on the presence and duration of transient proarrhythmic factors after PVI and the known high prevalence of ERAT in month 1, we felt that keeping patients entirely drug-free over this immediate post-PVI period would expose them to unnecessary inconvenience and arrhythmia. Another limitation of our study is that as we did not implant an implantable loop recorder in study participants, it is possible that some asymptomatic episodes of AT may have been missed during the monitoring period. However, PVI for paroxysmal AF is largely offered for symptomatic relief, and recommendations on repeat PVI are also likely to be made only on symptom grounds. As such, we did not feel that exposure study participants to additional invasive procedures for implant and explant of loop recorders merely to identify asymptomatic AT was likely to be worthwhile in terms of guiding future practice.

**Conclusions**

ERAT occurring beyond 4 weeks after PVI is associated with PVrc at repeat electrophysiology study and, in particular, is strongly associated with reconnection of >1 PV, with a high specificity (89%) and positive-predictive value (77%). ERAT limited only to the first 4 weeks after PVI, in the context of continued treatment with antiarrhythmic drugs, is unrelated to underlying PVrc and, therefore, seems to be because of transient factors. The relationship between ERAT beyond 4 weeks and postblanking AT recurrence merits further investigation to further define the true blanking period in paroxysmal AF.

**Sources of Funding**

This work was supported by an Investigator-Initiated Study grant (IIS-239) from Biosense Webster Inc. The funding source approved the study design but had no involvement in the collection, analysis, and interpretation of data, or in the writing of the article.

**Disclosures**

D.M. Todd received speaker fees from Boston Scientific and Medtronic; M.C.S. Hall received speaker fees from Medtronic, speaker fees and Fellowship support from Boston Scientific, and educational event support from Biosense Webster Inc; D. Gupta received speaker fees and research grants and fellowship support from Biosense Webster Inc. The other authors report no conflicts.

**References**


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_Circ Arrhythm Electrophysiol_. 2015;8:846-852; originally published online June 24, 2015; doi: 10.1161/CIRCEP.115.003095

_Circulation: Arrhythmia and Electrophysiology_ is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231

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Print ISSN: 1941-3149. Online ISSN: 1941-3084

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