

Early recurrence of atrial arrhythmias following pulmonary vein antral isolation: Timing and frequency of early recurrences predicts long-term ablation success



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BACKGROUND Early recurrence of atrial arrhythmia (ERAA) is common after atrial fibrillation (AF) ablation and is associated with long-term recurrence. However, the association between *timing* or *frequency* of ERAA and long-term ablation success remains unclear.

OBJECTIVE We aimed to examine whether timing or frequency of ERAA after pulmonary vein antral isolation (PVAI) affects long-term ablation success.

METHODS Three hundred AF patients (100 paroxysmal, 100 persistent, 100 long-standing persistent; mean age 59.5 ± 9.6 years, 79% male) undergoing PVAI were included. All patients underwent 30-day monitoring with mobile continuous outpatient telemetry after PVAI and were followed for >1 year. ERAA was defined as AF or organized atrial tachycardia (OAT) in the first 6 weeks, and was categorized as early (weeks 1–2), intermediate (weeks 3–4), or late (weeks 5–6). Long-term ablation success was defined as the absence of AF/OAT lasting >30 seconds off antiarrhythmic drugs 1 year after a single ablation (excluding first 6 weeks).

RESULTS ERAA occurred in 169 patients (53%); of those, 79 (46.7%) had single ERAA and 90 (53.3%) had multiple ERAAs. ERAA

occurred less commonly with paroxysmal versus persistent or long-standing persistent AF (46% vs 57% and 66%; $P = .017$). ERAA was associated with worse ablation success at 1 year (38.1% vs 79.5% [no ERAA]; $P < .001$). Multiple (vs single) ERAA more strongly predicted long-term ablation failure (OR: 4.5; 95% CI [2.3–8.8]).

CONCLUSIONS ERAA after PVAI is associated with decreased long-term ablation success. Patients experiencing multiple ERAA events are at greatest risk for long-term arrhythmia recurrence and represent a subgroup in whom early reablation may be considered.

KEYWORDS Arrhythmia; Atrial; fibrillation; Ablation; Pulmonary vein isolation; Monitoring

ABBREVIATIONS AAD = antiarrhythmic drug; AF = atrial fibrillation; BMI = body mass index; ERAA = early recurrence of atrial arrhythmia; ICD = implantable cardioverter-defibrillator; LA = left atrial; LV = left ventricular; MCOT = mobile continuous outpatient telemetry; OAT = organized atrial tachycardia; PV = pulmonary vein; PVAI = pulmonary vein antral isolation

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Introduction

Radiofrequency catheter ablation to achieve pulmonary vein antral isolation (PVAI) is considered an effective intervention for the management of atrial fibrillation (AF).^{1,2} Yet, early recurrences of atrial arrhythmias (ERAA) following AF ablation are common and have been reproducibly associated with long-term arrhythmia recurrence.^{3–10} However, since up to half of patients who experience ERAA remain AF-free

during long-term follow-up, guidelines recommend a “blanking period” of 3 months after the initial ablation, during which re-intervention in response to arrhythmia recurrence should be avoided.¹¹

Recent studies have suggested that an early reablation strategy in some patients experiencing ERAA may be beneficial.^{12,13} However, identifying which patients would most benefit from earlier re-intervention is challenging because it remains unclear which ERAA characteristics are predictive of long-term arrhythmia recurrences. It is also unclear whether ERAA events following PVAI have the same prognostic significance in patients with paroxysmal, persistent, and/or long-standing persistent AF. Therefore, the

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objective of this study was to examine the association between the timing and frequency of ERAA episodes following PVAI and long-term freedom from arrhythmias in a diverse AF population.

Methods

Study population and data collection

We identified patients with paroxysmal, persistent, and long-standing persistent AF who underwent ablation at the Hospital of the University of Pennsylvania between 2006 and 2011 and selected 100 patients of each AF type for inclusion. For this study, consecutive patients were retrospectively selected from our AF ablation database, going backwards in time from 2011. Since there were fewer patients with persistent and long-standing persistent (vs paroxysmal) AF, we had to go back further in time to identify 100 consecutive qualifying patients from these 2 AF types. Thus, the time periods of inclusion were January 2010–May 2011 for patients with PAF, August 2007–March 2011 for patients with persistent AF, and October 2006–January 2011 for patients with long-standing persistent AF. Included patients were limited to those who had undergone AF ablation for the first time, had completed their initial 30-day mobile continuous outpatient telemetry (MCOT) monitoring, and had at least 1 year of long-term follow-up after their ablation procedure. As per the 2012 HRS/EHRA/ECAS ablation consensus statement¹¹ and the 2014 AHA/ACC/HRS AF guidelines,¹⁴ persistent AF was defined as continuous AF lasting >7 days and long-standing persistent AF was defined as uninterrupted AF lasting \geq 12 months.

Baseline clinical, demographic, and echocardiographic characteristics at the time of ablation were collected. All participants provided written informed consent for the ablation procedure, as well as for inclusion in medical research, at the time of the procedure. The study was approved by the University of Pennsylvania Health System's Institutional Review Board.

Ablation procedure

The standard protocol for PVAI and non-pulmonary vein (PV) trigger ablation at our institution has been previously described.^{15,16} Briefly, antiarrhythmic drugs (AADs) were discontinued >5 half-lives before ablation in all patients (except amiodarone, which was discontinued >2 weeks prior to ablation). Catheters were placed in the coronary sinus and posterior right atrium and an intracardiac echocardiography catheter (Acuson, Malvern, PA) was advanced into the right atrium. A bolus of unfractionated heparin was then administered and heparin infusion was titrated to maintain an activated clotting time >325 seconds for the duration of the procedure. Subsequently, 2 transeptal punctures were performed, through which the ablation and decapolar circular mapping catheters were advanced into the left atrium. Wide-area circumferential PVAI was performed by isolating the left and right pulmonary veins as ipsilateral common ostia, following which attempts at induction of non-

PV triggers with subsequent ablation were performed, as previously described.¹⁵

Acute procedural success was defined as entrance and exit block at least 20 minutes after initial isolation; those veins with acute reconnection were re-isolated.¹⁷ Immediately following PVAI, reproducibly induced organized atrial tachyarrhythmias (OATs; atrial tachycardias or atrial flutter) were also targeted as guided by activation and/or entrainment mapping.

Postablation follow-up

Following the ablation procedures, all patients were discharged on an AAD and either warfarin or a non-vitamin K oral anticoagulant. Additionally, each patient was sent home with an MCOT device (Lifewatch, Rosemont, IL; CardioNet, Malvern, PA; or Medicomp Inc, Melbourne, FL) for continuous monitoring for 30 days postablation. The MCOT unit continuously transmits recordings, which are reviewed at each company's monitoring center. Arrhythmias are reviewed and categorized by the monitoring center and are then made available online for the care providers. For this study, every MCOT transmission was further reviewed and confirmed by one of the study investigators (J.J.L.). Patients were seen for follow-up in the outpatient clinic at the Hospital of the University of Pennsylvania at 6 weeks, 6 months, and 1 year after ablation. Routine practice at our institution is to perform a 30-day MCOT around the 6-month and 1-year follow-up appointments; additional MCOTs were prescribed if the patients reported symptoms suggestive of arrhythmia recurrences. In the absence of documented arrhythmia recurrence, AADs were typically discontinued at the 6-week visit in patients with paroxysmal AF and between 3 and 6 months postablation in patients with persistent or long-standing persistent AF.

Recurrences of atrial arrhythmias and long-term ablation success

The outcomes of interest were *early recurrence of atrial arrhythmias* (ERAA) and *long-term ablation success* following the initial procedure. We defined ERAA as any AF or OAT lasting >30 seconds within the first 6 weeks following PVAI ("censor period"). For each ERAA event in the censor period, we collected ERAA type (AF/OAT) as well as timing. ERAA events were then categorized into the following time periods: (1) *early* ERAA (occurring within first 2 weeks postablation); (2) *intermediate* ERAA (occurring within weeks 3-4 postablation); and (3) *late* ERAA (occurring within weeks 5-6 postablation). One or more ERAA episodes occurring in the same time period were categorized as a single time period event, whereas 1 or more ERAA episodes occurring in different time periods were categorized as multiple time period events. ERAA events occurring in one time period that continued uninterrupted into a subsequent time period were counted as occurring only in the time period during which the events began. Since our standard practice is to perform 30 days of ambulatory

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