

Lengthening the atrioventricular delay reduces large left atrial v waves and dyspnea after atrial fibrillation and tachycardia ablation



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Introduction

Pulmonary vein isolation (PVI) remains the cornerstone of therapy for patients with drug-refractory paroxysmal atrial fibrillation; and recent studies have suggested that even for patients with persistent atrial fibrillation, addition of linear lesions to PVI may not confer any advantage in efficacy.^{1–3} Despite this, patients with significant left atrial fibrosis and chamber enlargement may have additional substrate for atrial fibrillation or tachycardia that remains after PVI because of nonpulmonary vein (PV) substrate requiring further ablation.^{4–6} These additional lesions may have effects on left atrial conduction and physiology through a variety of mechanisms including alteration of left atrial compliance as suspected in stiff left atrial syndrome and alteration of left atrial and left ventricular synchrony.^{7–11} Two cases are presented here in patients with previous permanent pacemakers undergoing PV and substrate ablation for atrial fibrillation and/or atrial tachycardia, leading to variable degrees of left atrial appendage (LAA) delay causing abnormal hemodynamics and symptoms, which were improved by lengthening the pacemaker atrioventricular delay (AVD).

Case reports

Patient 1

A 66-year-old male patient with obstructive sleep apnea, diabetes, hypertension, and preexisting complete heart block with a dual-chamber pacemaker underwent radiofrequency catheter ablation for symptomatic, drug-refractory (sotalol) atrial fibrillation and atrial tachycardia despite ventricular rate control due to heart block. A preprocedural echocardiogram showed a left ventricular ejection fraction of 60%, mild left ventricular hypertrophy, a left atrial volume index of 33 mL/m², no significant mitral regurgitation, and pulmonary artery systolic pressures of

35–40 mm Hg. High-density mapping of the left atrium and ablation were performed with PentaRay NAV and ThermoCool SmartTouch catheters (Biosense Webster Inc., Diamond Bar, CA). After PVI, 2 morphologies of atrial tachycardia were easily inducible with single atrial extrastimuli, which matched his clinical atrial tachycardia. Mapping and concealed entrainment revealed a roof mediated tachycardia and an anterior wall tachycardia, both of which were successfully ablated after creation of a linear roofline and lesions in the anterior left atrium. No further arrhythmias were inducible with triple atrial extrastimuli or burst pacing down to 180 ms. Hemodynamic tracings were recorded through the transseptal sheath upon initial transseptal puncture as well as throughout the case. The effects of varying the AVD were examined postablation. The observation of large left atrial v waves prompted further investigation of the left atrial conduction times and the effect of varying the AVD of the pacemaker.

Patient 2

Patient 2 had undergone ablation almost 8 months before patient 1. Three years before ablation, he had undergone implantation of a cardiac resynchronization therapy (CRT)–defibrillator for ischemic cardiomyopathy and a left ventricular ejection fraction of 30% with alternating bundle branch block and syncope. He subsequently developed symptomatic, drug-refractory (dofetilide) atrial fibrillation. A preprocedural echocardiogram showed a previous anteroapical infarction, a left ventricular ejection fraction of 40%, and a left atrial volume index of 42 mL/m². High-density mapping of the left atrium and ablation were performed with Lasso circular mapping and ThermoCool SmartTouch catheters (Biosense Webster Inc.). He also underwent roofline and focal anterior ablation for low-amplitude fractionated signals along the anterior left atrium, which were present in sinus rhythm, because of recurrent spontaneous atrial fibrillation despite cardioversion after PVI and PVI + roofline but not after delivery of the anterior lesions. At follow-up, he complained of dyspnea with activities of daily living and was effectively in New York Heart Association functional class II–III despite being in sinus rhythm with appropriate CRT pacing. He noted this to be much worse than when he had been cardioverted and held sinus rhythm for 1 month in the year before

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KEY TEACHING POINTS

- Left atrial appendage activation time in sinus rhythm should be assessed before and after atrial fibrillation ablation and compared to the PR interval.
- Placement of anterior lesions should take into consideration the effects on left atrial appendage activation.
- Patients with PR prolongation or heart block and a dual-chamber or cardiac resynchronization therapy–pacemaker who experience this phenomenon may be helped by reprogramming the atrioventricular delay beyond the measured activation time to the left atrial appendage.

ablation. Further workup included cardiac computed tomography showing no PV stenosis, nuclear myocardial single-photon emission computed tomography imaging showing previous infarct with mild peri-infarct ischemia, cardiac catheterization revealing normal filling pressures and no significant

stenosis aside from the previously occluded mid left anterior descending, fluoroscopy showing no phrenic nerve palsy, echocardiography showing no pulmonary hypertension or mitral regurgitation and a left ventricular ejection fraction of 40%, and normal pulmonary function test results. Based on knowledge gained from patient 1, sinus activation maps were reexamined pre- and postablation, based on which the AVD of his CRT-pacemaker was prolonged from 110 to 160 ms, which did not cause fusion or decreased CRT pacing.

Results

In patient 1, the left atrial hemodynamic waveform was normal at baseline with a mean pressure of 15 mm Hg and v waves to 21 mm Hg (Figure 1A); however, postablation it revealed a mean pressure of 27 mm Hg with large v waves up to 35–40 mm Hg (Figure 1B). Intracardiac echocardiography did not show any significant mitral regurgitation by color-flow or pulsed wave Doppler. Examination of LAA intracardiac electrograms revealed that activation which was before the QRS complex at baseline and 120 ms after the atrial pacing spike (Figure 1D) was now at 310 ms postablation and after the paced QRS (Figure 1E). Small left atrial P waves are even visible in the ST segment (Figure 1E, yellow oval).

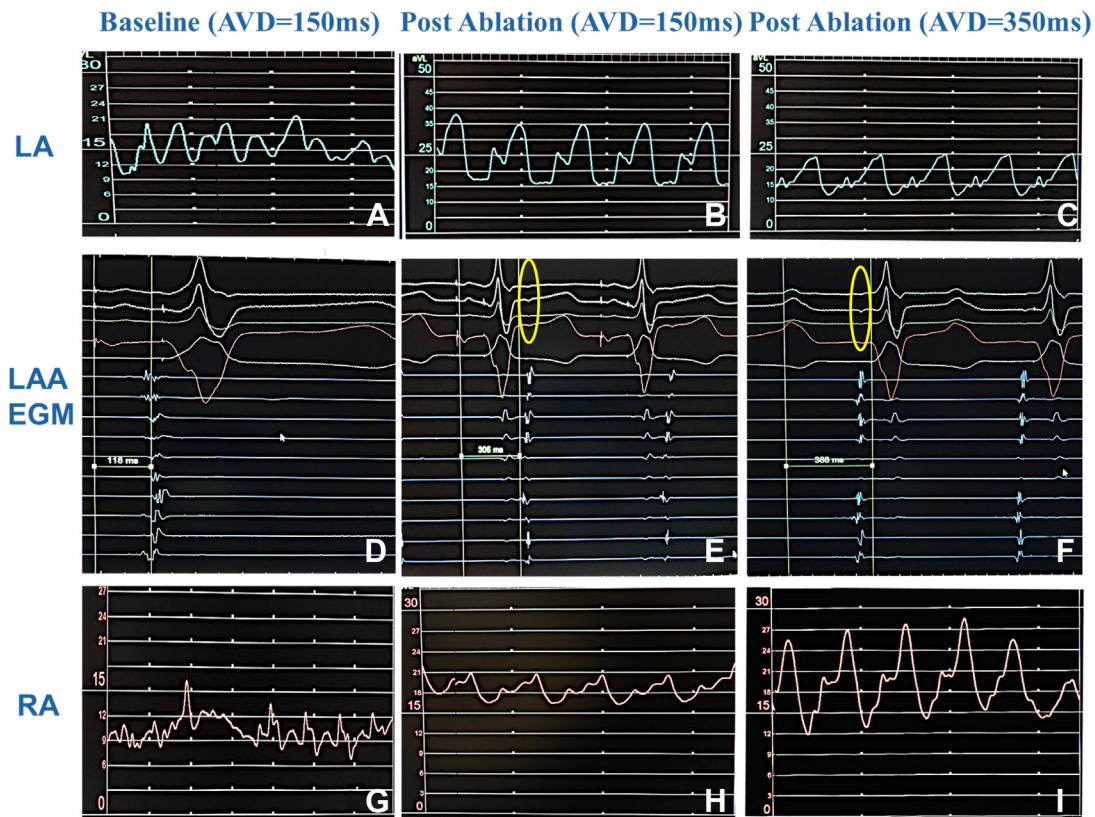


Figure 1 Patient 1: Atrioventricular delay (AVD) effects on left and right atrial pressures with respect to intracardiac left atrial appendage (LAA) electrograms (EGMs). **Column 1 Baseline AVD 150 ms:** (A) left atrial (LA) pressures @ 30-mm scale, (D) LAA electrograms occurring at 118 ms after the atrial pacing spike, and (G) right atrial (RA) pressure @ 30-mm scale at an AVD of 150 ms. **Column 2 Postablation AVD 150 ms:** (B) LA pressures @ 50-mm scale with large v waves, (E) LAA electrograms now delayed to 306 ms after the QRS with the delayed left atrial P wave in the ST segment (yellow oval), and (H) RA pressure. **Column 3 Postablation AVD 350 ms:** (C) reduction of LA v waves @ 50-mm scale, (F) LA electrograms and delayed LA P wave (yellow oval) now occurring before the QRS, and (I) elevation of RA a waves @ 30-mm scale

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