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Original Article

Efficacy of ablation at the anteroseptal line for the treatment of perimitral flutter

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ABSTRACT

Background: Left atrial flutter following atrial fibrillation (AF) ablation is increasingly common and difficult to treat. We evaluated the safety and efficacy of ablation of the anteroseptal line connecting the right superior pulmonary vein (RSPV) to the anteroseptal mitral annulus (MA) for the treatment of perimitral flutter (PMF).

Methods: We systematically studied patients who were previously treated with AF ablation and who presented to the electrophysiology laboratory with atrial tachyarrhythmias between January 2000 and July 2010. The diagnosis of PMF was confirmed by activation mapping and/or entrainment. After re-isolation of any recovered pulmonary vein, a linear radiofrequency (RF) ablation was performed on the line that connected the RSPV to the anteroseptal MA. In this analysis, we included only patients who were treated with an anteroseptal line for their PMF.

Results: Ablation was performed at the anteroseptal line in 27 PMF patients (63 ± 13 years; 9 women) who had undergone prior ablation for paroxysmal ($n=3$) or persistent ($n=24$) AF, using electroanatomic activation mapping (70% CARTO, 30% NavX). The anteroseptal ablation line was effective in 22/27 (81.5%) patients in the acute-care setting. Termination of AF to sinus rhythm occurred in 15/22 (68.2%) patients, and 7/22 (31.8%) patients' AF converted to another right or left atrial flutter. At the 6-month follow-up, 20% of patients demonstrated recurrent left atrial tachyarrhythmia. Only one patient required repeat ablation, and the remaining patients' condition was controlled with antiarrhythmic medications. No major procedural complications or heart block occurred.

Conclusion: Ablation at the left atrial anteroseptal line is safe and efficacious for the treatment of PMF. Unlike ablation at the traditional mitral isthmus line, ablation at the left atrial anteroseptal line does not require ablation in the coronary sinus.

1. Introduction

Atrial fibrillation (AF) is the most common sustained arrhythmia, and as the average age of the population increases, the incidence of AF will continue to rise [1,2]. The past decade has seen the steady advance of catheter-based approaches to the management of AF.

Fortunately, serious complications arising from AF ablation have declined as collective experience has increased and techniques have improved. Pulmonary vein stenosis, atrial-esophageal fistula, cerebral vascular accidents, and coronary artery injury are now uncommon complications [3]. Despite these advances, the prevalence of late-onset postprocedural left atrial (LA) flutter remains as high as 10% [4]. Presumably, in LA flutter, the conversion of AF to a more organized reentrant circuit results in the development of macroreentrant atrial tachycardias. These tachycardias possibly result from "proarrhythmic" lesion sets that create areas of slow conduction, predisposing the circuit to reentry [5].

Perimitral flutter (PMF) is responsible for a considerable percentage of cases of macroreentrant LA flutter, especially in the setting of AF ablation [6]. Despite recent technological

Abbreviations: AAD, Antiarrhythmic drug; AF, Atrial fibrillation; CS, Coronary sinus; CTI, Cavotricuspid isthmus; ICE, Intracardiac echocardiography; LA, Left atrium; LAA, Left atrial appendage; MA, Mitral annulus; PMF, Perimitral flutter; PVI, Pulmonary vein isolation; RF, Radiofrequency; RSVP, Right superior pulmonary vein

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Table 1
Baseline characteristics of the perimitral flutter study population ($n=27$).

Patient characteristics	
Age (years)	63 ± 13
Women	33.33%
Ejection fraction	52% (23%–65%)
Structural heart disease	
No heart disease	11/27
Ischemic heart disease	2/27
Valvular heart disease	4/27
Medications	
Beta blockers	11/27
Calcium-channel blockers	8/27
Digoxin	3/27
Amiodarone	1/27
Dofetilide	3/27
Sotalol	3/27
Class IC antiarrhythmics	8/27

advances and a better understanding of the anatomy, mitral isthmus ablation remains technically challenging, often requiring substantial ablation (>15 min of radiofrequency [RF] energy), high ablation powers (≤ 50 W), and epicardial ablation within the coronary sinus (CS) in approximately 70% of patients. Even so, success rates for mitral isthmus ablation in the acute setting are only moderately high [7].

The present study sought to evaluate the feasibility, safety, and efficacy of ablation at the LA anteroseptal line connecting the right superior pulmonary vein (RSPV) to the anteroseptal mitral annulus (MA) for the treatment of PMF.

2. Material and methods

2.1. Study population and follow-up

We retrospectively analyzed patients who were treated for PMF with catheter ablation for atrial tachyarrhythmias, at the anteroseptal line connecting the RSPV to the anteroseptal MA. The study was approved by the Institutional Review Board of the Cleveland Clinic Foundation.

From June 2000 to July 2010, ablation at the anteroseptal line was performed in 27 patients with PMF that was either the presenting arrhythmia or an organized intermediate rhythm during AF ablation. All patients provided written informed consent. The baseline characteristics of the study population are presented in Table 1.

During the first 3 months after ablation, patients used an event recorder to monitor for arrhythmias and recorded them on a weekly basis and whenever they were symptomatic. Additional event recorder monitoring was obtained beyond the 3-month period if patients either had atrial tachyarrhythmia within the first 3 months or had symptoms consistent with arrhythmia. Patients underwent 24-h Holter ECG at 3 months, 6 months, and every 6 months thereafter. Follow-up visits were scheduled at 3, 6, and 12 months after ablation and yearly thereafter when possible. More frequent follow-up was scheduled for patients who had symptoms, arrhythmia recurrence, or complications from the procedure. All patients underwent transthoracic echocardiography within 3 months before ablation, echocardiography, and cardiac computed tomography to assesses for possible pulmonary vein (PV) stenosis at 3 months after ablation.

Arrhythmia recurrence was identified when patients reported symptoms consistent with arrhythmia and/or when an atrial tachyarrhythmia lasting 30 s was captured on a 12-lead ECG, event recording, or Holter monitor recording. Without such documentation, patients were considered arrhythmia-free. Antiarrhythmic drugs (AADs) were used during the first 2 months after ablation and were then stopped unless continued arrhythmia indicated their use, in which case patients were considered to have arrhythmia recurrence.

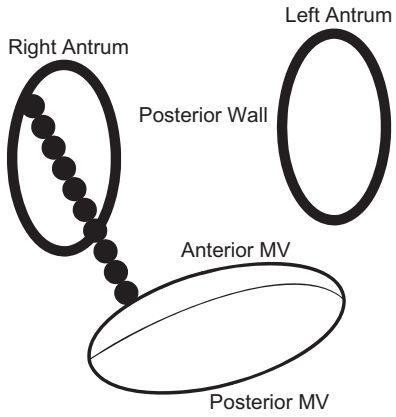

Fig. 1. Schematic representation of the anteroseptal line joining the right superior antrum with the anteroseptal mitral annulus.

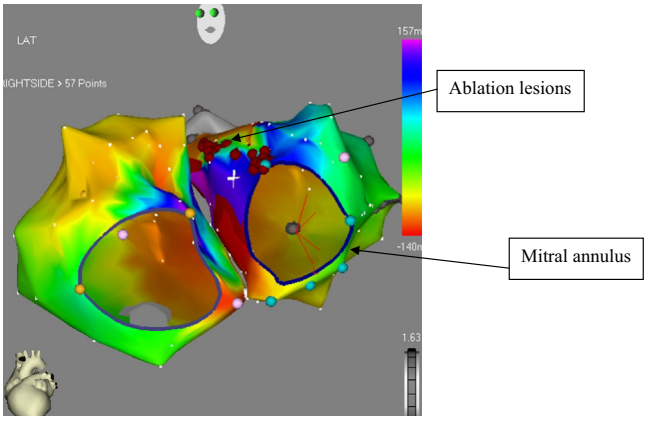

Fig. 2. Electroanatomic map of the right and the left atrial chambers of a patient with perimitral flutter with RF ablation line from the RSPV to the anteroseptal MA.

2.2. Ablation strategy

We have previously described our pulmonary vein isolation (PVI) and periprocedural anticoagulation protocols in detail [8,9]. Briefly, all AADs were stopped 4–5 half-lives before ablation, with the exception of amiodarone, which was discontinued $\geq$4–5 months before the procedure. A transesophageal echocardiogram was obtained for patients presenting with AF if they had a subtherapeutic international normalized ratio ≤ 3 weeks before ablation. A 10-Fr phased-array intravascular ultrasound catheter (Siemens AG Inc., Malvern, PA, USA) was placed in the right atrium to assist with performing transseptal punctures, to guide catheter location and manipulation within the LA, and to monitor for cardiac complications during ablation. In all patients, all PV antra were re-isolated under intracardiac echocardiographic (ICE) guidance.

After completion of the re-isolation of the PV antra, the PMF was mapped using the NavX or CARTO 3-dimensional (3D) electroanatomic system and then confirmed by entrainment from the proximal, distal coronary sinus and the anterior mitral annulus.

2.3. Ablation at the anteroseptal line and verification of block across the line

The anteroseptal line was created between the anterior/anteromedial aspect of the mitral annulus and the ostium of the RSPV (Fig. 1). The ablation catheter was advanced through the transseptal sheath to the anterior/anteromedial mitral annulus, and delivery of