Posterior wall isolation using the cryoballoon in conjunction with pulmonary vein ablation is superior to pulmonary vein isolation alone in patients with persistent atrial fibrillation: A multicenter experience

Arash Aryana, MS, MD,* James H. Baker, MD,† Martin A. Espinosa Ginic, MD,† Deep K. Pujara, MBBS,‡ Mark R. Bowers, MS, MD,* P. Gearoid O'Neill, MD,* Kenneth A. Ellenbogen, MD,§ Luigi Di Biase, MD, PhD,‖ André d'Avila, MD, PhD,¶ Andrea Natale, MD#

*From the *Dignity Health Heart and Vascular Institute, Mercy General Hospital, Sacramento, California, †Saint Thomas Heart, Nashville, Tennessee, ‡University of Texas School of Public Health, Houston, Texas, §Virginia Commonwealth University Medical Center, Richmond, Virginia, ‖Albert Einstein College of Medicine, Montefiore Hospital, Bronx, New York, ¶Cardiac Arrhythmia Research Institute, Cardiac Hospital of Florianopolis, Florianopolis, Santa Catarina, Brazil, and #Texas Cardiac Arrhythmia Institute, St. David's Medical Center, Austin, Texas.*

BACKGROUND Pulmonary vein isolation (PVI) in conjunction with isolation of the posterior left atrial wall (PVI+PWI) is associated with improved clinical outcomes in certain patients with atrial fibrillation (AF).

OBJECTIVE The purpose of this multicenter study was to evaluate the acute and long-term outcomes of PVI+PWI vs PVI alone performed using cryoballoon ablation in patients with persistent AF (persAF).

METHODS We examined the procedural safety and efficacy and short- and long-term outcomes in 390 consecutive patients with persAF who underwent a first-time cryoballoon ablation procedure using PVI+PWI (n = 222 [56.9%]) vs PVI alone (n = 168 [43.1%]).

RESULTS Acute isolation was achieved in 99.7% of all pulmonary veins (PVI+PWI = 99.8% vs PVI alone = 99.3%; $P = .23$) using 6.3 ± 1.4 applications and 17 ± 2 minutes of cryoablation. PWI was achieved using 13.7 ± 3.2 applications and 34 ± 10 minutes of cryoablation. Adjunct radiofrequency ablation was required in 1.8% of patients to complete PVI (4 ± 2 minutes) and in 32.4% to complete PWI (5 ± 2 minutes). PVI+PWI yielded significantly greater posterior wall (77.2% ± 6.4% vs 40.6% ± 4.9%; $P < .001$) and total left atrial (53.3% ± 4.2% vs 36.3% ± 3.8%; $P < .001$) isolation. In addition, PVI+PWI was associated with greater AF termination (19.8% vs 8.9%; $P = .003$) and conversion to atrial flutters (12.2% vs 5.4%; $P = .02$). Adverse events were similar in both groups, whereas recurrence of AF and all atrial arrhythmias was lower with PVI+PWI at 12 months of follow-up. Moreover, in a Cox regression analysis, PVI+PWI emerged as a significant predictor of freedom from recurrent atrial arrhythmias (hazard ratio: 2.04; 95% confidence interval: 1.15–3.61; $P = .015$).

CONCLUSION PVI+PWI can be achieved safely and effectively using the cryoballoon. This approach appears superior to PVI alone in patients with persAF.

KEYWORDS Catheter ablation; Cryoablation; Cryoballoon; Persistent atrial fibrillation; Pulmonary vein isolation; Posterior wall isolation

(Heart Rhythm 2018;15:1121–1129)

This work was supported financially in part by a research grant from Medtronic. Drs Aryana, Baker, Bowers, Di Biase, Ellenbogen, Natale, and O'Neill have received consulting fees and speaker honoraria from Medtronic. Drs Aryana, Baker, and O'Neill have received research grants from Medtronic. **Address reprint requests and correspondence:** Dr Arash Aryana, Department of Cardiology and Cardiovascular Surgery, Dignity Health Heart and Vascular Institute, Mercy General Hospital, 3941 J St, Suite #350, Sacramento, CA 95819. E-mail address: a_aryana@outlook.com.

1547-5271/$-see front matter https://doi.org/10.1016/j.hrthm.2018.05.014

Introduction

The success rate associated with catheter ablation of persistent atrial fibrillation (persAF) remains low, with wide variations in ablation techniques among operators.[1] Although pulmonary vein (PV) isolation (PVI) remains the cornerstone of atrial fibrillation (AF) ablation,[2] several studies[3–7] have suggested a benefit associated with wide area antral PV ablation and concomitant isolation of the posterior left atrial wall (PLAW) lying between the PVs. This is plausible since PLAW shares its embryological origins with the primordial PVs.[8] In addition, prior reports have described presence of rotors and spontaneous triggers within the PLAW.[9] While the reported experience with PLAW isolation (PWI) involves predominantly the use of point-by-point radiofrequency ablation (RFA), there remains limited data on the use of cryoballoon for this approach since balloon-based strategies are typically used for PVI only. But given that the lesions created using the second-generation cryoballoon are typically large[10] and durable,[11] utilization of the cryoballoon to achieve PWI seems conceptually attractive as an ablation technique. Consequently, in this multicenter study with a nonrandomized prospective design, we analyzed the procedural characteristics and acute and long-term safety and efficacy outcomes of PVI with PWI (PVI+PWI) performed using the second-generation cryoballoon in a cohort of patients with symptomatic persAF. These outcomes were then retrospectively compared with those in a matched cohort of control patients who only received PVI using the cryoballoon.

Methods

Study patients

The study cohort consisted of 390 consecutive patients undergoing a first-time cryoballoon ablation procedure for symptomatic persAF between October 1, 2014 and February 28, 2017. In the initial phase of the study, all patients consecutively received PVI+PWI (n = 222 [56.9%]), whereas in the later study phase, for comparison, all patients underwent PVI only (n = 168 [43.1%]). The same individual operators performed both ablation strategies. Approval for this study was granted by each facility's institutional review board.

PVI

Our techniques for catheterization have been previously reported.[12] Briefly, all patients underwent PVI using a 28-mm cryoballoon (Arctic Front Advance, Medtronic, Inc., Minneapolis, MN), inserted via a 12-F steerable sheath (FlexCath, Medtronic, Inc.) over a circular inner lumen mapping catheter/guidewire (Achieve, Medtronic, Inc.). Based on the available data,[12] between one and two 120- to 180-second cryoapplications were delivered to each PV guided by time to PVI. A detailed postablation 3-dimensional (3-D) electroanatomic map (CARTO, Biosense Webster, Inc., Irvine, CA or NavX, Abbott, St. Paul, MN) was created in each patient (number of points collected: 991 ± 193) using a high-density mapping catheter (PENTARAY, Biosense Webster, Inc. or Inquiry AFocus II, Abbott). In addition, PVI was confirmed by testing for entrance/exit block and after administration of intravenous adenosine. Luminal esophageal temperature (LET) was monitored throughout ablation. LET<15°C resulted in the immediate termination of an application. During cryoablation of the right PVs, high-output right phrenic nerve stimulation (10–25 mA; 1000–1200 ms) was performed using a diagnostic electrophysiology catheter from the superior vena cava. Whenever diminished/loss of pacing capture was observed, cryoablation was terminated. Persistent phrenic nerve palsy was defined by continued loss of function that failed to resolve by the end of the procedure.

PVI+PWI

Once PVI was completed, the cryoballoon was used to perform PWI in those undergoing this treatment. The catheter maneuvers to achieve PWI are illustrated in Figure 1. Briefly, by anchoring the inner lumen catheter/guidewire in one of the PVs, the PLAW was ablated in a segmental fashion. For ablation of superior PLAW segments, the inner lumen catheter/guidewire was typically anchored inside the superior PVs, whereas the right inferior PV was more commonly used for ablation of the inferior segments of the PLAW because of its more posterior takeoff. Advancing/retracting the inner lumen catheter distally/proximally within the PV allows the operator to position the cryoballoon along the different segments of the PLAW. Since the maximum cooling zone spans the distal surface of the cryoballoon, it is imperative to align the balloon in such a way that this surface area is in direct contact with the targeted tissue. To achieve this, the operator will also need to rely on the deflection of the steerable sheath and at times the balloon itself, as well as clockwise (when targeting the left PLAW segments) and counterclockwise (when targeting the right PLAW segments) rotations of the apparatus. In addition to tactile feel and fluoroscopy, this is facilitated by intracardiac echocardiographic guidance. Moreover, CARTOSound image integration (Biosense Webster, Inc.) may be used to further record the precise balloon locations along the PLAW (Figure 2). The operator must ensure that the applications are overlapping.

Meanwhile, a single 120- to 180-second cryoapplication was delivered at each site. LET was monitored throughout ablation, and temperatures <15°C were avoided. Once completed, PWI was confirmed by testing for entrance/exit block and after administration of intravenous adenosine. In addition, a detailed postablation 3-D map was created in each patient using a high-density mapping catheter (number of points collected: 1045 ± 187).

RFA

Whenever the PVs could not be isolated and/or PWI could not be achieved using cryoablation alone, point-by-point RFA was used. Furthermore, arrhythmias other than AF (ie, atrial flutter/tachycardia) were targeted using the same. RFA was always performed using an externally