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Safety and Efficacy of Cryoablation in Patients With Ventricular Arrhythmias Originating From the Para-Hisian Region

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ABSTRACT

OBJECTIVES This study aimed to assess the outcome of cryoablation in patients with ventricular arrhythmias (VAs) originating from the para-Hisian region.

BACKGROUND There are few data regarding the outcome of cryoablation in patients with VAs originating from the para-Hisian region, where there is the risk of injury to the conduction system.

METHODS The study analyzed all patients undergoing cryoablation at the Mayo Clinic (Rochester, Minnesota) as part of an ablation for VAs originating from the para-Hisian region.

RESULTS The study population consisted of 10 patients (64 ± 15 years of age, 7 men). Cryoenergy was applied after an unsuccessful radiofrequency (RF) ablation in 8 (80%) patients. The VAs were successfully ablated with cryoablation in 7 (70%) patients; RF ablation after an unsuccessful cryoablation eliminated the VAs at almost the same location with careful monitoring in 1 patient. The authors could not ablate the actual focus because a transient atrioventricular block developed during cryo- and RF energy applications, which led to an unsuccessful ablation in the remaining 2 patients. A complete atrioventricular block occurred during the cryoenergy application in 1 patient, who needed a permanent pacemaker implantation. There were no VA recurrences in 4 of 8 (50%) patients with procedural success during a median follow-up period of 122 days (interquartile range: 43 to 574 days).

CONCLUSIONS Cryoablation is clinically effective in some patients with VAs originating from the para-Hisian region, where there is the risk of injury to the conduction system, and therefore should be considered as an alternative to or in addition to RF ablation in these cases. Cryoablation requires care because it can also lead to major complications. (J Am Coll Cardiol EP 2018;■:■–■) © 2018 by the American College of Cardiology Foundation.

Radiofrequency (RF) ablation is the gold standard for the catheter-based ablation of ventricular arrhythmias (VAs) and supraventricular arrhythmias due to its larger and deeper lesion creation (1,2). However, cryoablation is considered as an alternative energy source when there is the risk of injury to critical structures such as the His bundle (3,4). In addition, cryoablation has been used to improve catheter stability and energy delivery in cases in which RF ablation fails (3,5).

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All authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the *JACC: Clinical Electrophysiology* author instructions page.

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ABBREVIATIONS AND ACRONYMS

AVB = atrioventricular block

LV = left ventricle/ventricular

PVC = premature ventricular contraction

RF = radiofrequency

RV = right ventricle/ventricular

VA = ventricular arrhythmia

There are, however, few data regarding the safety and efficacy of cryoablation with respect to VAs originating from the para-Hisian region, where there is the risk of injury to the conduction system. This study aimed to assess the outcome of cryoablation in patients with VAs originating from the para-Hisian region.

METHODS

STUDY POPULATION. We retrospectively analyzed all patients undergoing cryoablation as part of an ablation for VAs origination from the para-Hisian region between April 1, 2008, and February 28, 2017, at the Mayo Clinic (Rochester, Minnesota). Cryoablation was performed in patients with VAs originating from the para-Hisian region due to the potential risk of injury to the His bundle. The study was approved by the Institutional Review Board, and written informed consent was obtained from all patients before the procedure. Patients who underwent cryoablation for other reasons, such as for VAs originating from a non-para-Hisian region, or supraventricular tachycardia ablation, were excluded. We assessed the clinical characteristics, procedural success, complications, and clinical success.

ELECTROPHYSIOLOGICAL STUDY. Steerable multielectrode catheters were positioned in the coronary sinus, His bundle region, and right ventricular (RV) apex for recording and pacing. Intracardiac echo and fluoroscopy were used as a means to locate the cardiac structures and assess the pericardial space during the procedures.

Programmed ventricular extrastimulation of up to 3 extrastimuli and burst pacing from the RV or left ventricle (LV) was performed at baseline and after an isoproterenol infusion. The 3-dimensional geometry, voltage map, or activation map of the chamber of interest were depicted by the CARTO version 3, XP (Biosense Webster, Diamond Bar, California) mapping system. Pace mapping was also used to determine the origin of the VA. It was performed with a pacing cycle of 600 ms, pulse width of 2 ms, and at twice the diastolic threshold. The location of the His bundle electrograms was assessed in both the RV and LV. A retrograde transaortic approach was used to access the LV.

ABLATION PROCEDURE. Cryoenergy or RF energy were delivered at myocardial sites exhibiting the earliest ventricular activation, a local unipolar QS pattern, or perfect pace mapping. For cryoablation, we used a 4-mm or 6-mm-tip cryoablation catheter (Freezor, Medtronic, Minneapolis, Minnesota). At first, cryomapping at -30°C was performed to assess the electrical conductivity by a cryoenergy application when using 4-mm-tip catheter. Only when the cryomapping was safe, a 4-min ablation freeze with a target temperature of -70 to -80°C was applied while monitoring the conduction system. For RF ablation, we used an open irrigated tipped catheter (Thermocool, Biosense Webster). RF energy was delivered for up to 2 min in a power-controlled mode as follows: a power of 30 to 50 W and an irrigation rate of 17 to 30 ml/min.

After the ablation, programmed RV stimulation was repeated to induce the VAs. The endpoint of the catheter ablation was the elimination and subsequent noninducibility of VAs during an isoproterenol infusion, programmed ventricular extrastimulation, and burst pacing.

DEFINITIONS OF THE PROCEDURAL AND CLINICAL OUTCOMES. Procedural and clinical success was defined as follows.

1. Procedural outcome: defined as successful if there was an elimination and noninducibility of the clinical VA. A procedure was deemed as failed if the clinical VA was not eliminated, or if it was inducible with isoproterenol or programmed stimulation.
2. Clinical outcome: defined as successful if the VA burden with Holter recordings was reduced by more than 80% when compared with a pre-procedure recording, and there was the absence of arrhythmia symptoms at the last follow-up, either on or off antiarrhythmic drugs (6). Clinical failure was defined as the presence of symptoms or clinical VAs despite antiarrhythmic drugs, requiring a repeat procedure, and/or no significant reduction in the VA burden with follow-up Holter recordings (<80% burden reduction).

FOLLOW-UP. All patients underwent at least 24 h of continuous monitoring of their electrocardiograms after the ablation procedure. Patients underwent serial physical examinations, complete blood counts, and recording of the electrocardiogram and transthoracic echocardiogram. After hospital discharge, patients were followed via telephone interviews at 30 days in addition to the follow-up recommended by their primary cardiologist. A 24-h Holter recording was obtained before and 1 to 3 months after the ablation. When patients had symptoms, additional Holter recordings were performed at our institute or the outpatient clinic.