Case Reports

Possible Role for Cryoballoon Ablation

of Right Atrial Appendage Tachycardia when Conventional Ablation Fails

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Focal atrial tachycardia arising from the right atrial appendage usually responds well to radiofrequency ablation; however, successful ablation in this anatomic region can be challenging. Surgical excision of the right atrial appendage has sometimes been necessary to eliminate the tachycardia and prevent or reverse the resultant cardiomyopathy. We report the case of a 48-year-old man who had right atrial appendage tachycardia resistant to multiple attempts at ablation with use of conventional radiofrequency energy guided by means of a 3-dimensional mapping system. The condition led to cardiomyopathy in 3 months. The arrhythmia was successfully ablated with use of a 28-mm cryoballoon catheter that had originally been developed for catheter ablation of paroxysmal atrial fibrillation. To our knowledge, this is the first report of cryoballoon ablation without isolation of the right atrial appendage. It might also be an alternative to epicardial ablation or surgery when refractory atrial tachycardia originates from the right atrial appendage. ***(Tex Heart Inst J 2015;42(3):289-92)***

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Right atrial appendage (RAA) atrial tachycardia (AT) typically responds well to radiofrequency (RF) ablation; however, successful ablation in this anatomic region can be challenging. Sometimes surgical excision of the RAA is the only way to eliminate the AT.[1,2] Moreover, mapping and RF ablation inside the thin-walled RAA raises the possibility of perforation. We report a case of incessant RAA tachycardia that led to cardiomyopathy in 3 months. The condition was refractory to conventional ablation approaches. We discuss our curative use of the cryoballoon catheter technique, which was originally developed to isolate the pulmonary veins for the elimination of paroxysmal atrial fibrillation.

Case Report

In June 2013, a 48-year-old man with incessant, drug-refractory AT was referred for ablation. He had a 3-month history of palpitations, limited exercise capacity, and shortness of breath. One month earlier, ablation had failed to correct AT that arose from the upper part of the crista terminalis. Antiarrhythmic drugs had failed to control the arrhythmia or ventricular response rate: metoprolol (200 mg/d in 2 equal doses for 2 wk) and verapamil (240 mg/d for another 2 wk), followed by amiodarone (loading dose of 1.2 g intravenously, then 600 mg/d in 3 equal doses in 24 hr for one mo). After these, propafenone (450 mg/d in 3 equal doses) in combination with metoprolol (50 mg/d) had been given for another month. At the current presentation, physical examination yielded normal results except for a heart rate of 130 beats/min. The patient's left ventricular (LV) ejection fraction was 0.45 on echocardiography. An electrocardiogram (ECG) revealed an AT at a heart rate of 135 beats/min. Results of laboratory tests, including thyroid function, were normal.

All antiarrhythmic medications were discontinued for at least 5 half-lives, and the patient was taken to the electrophysiology laboratory. Results of electroanatomic mapping with use of the CARTO® 3 System (Biosense Webster, a Johnson & Johnson company; Diamond Bar, Calif) showed normal right atrial morphology, an eccentric atrial activation from the proximal portion of the RAA (cycle length, 430 ms), and a ventriculoatrial interval of 230 ms, measured from the high right atrial catheter. The tachycardia was incessant and unresponsive to overdrive pacing. The earliest local electrogram recorded from the base and mid portion of the RAA preceded the P wave on surface ECG by 30 ms (Fig. 1); sinus rhythm was not restored by several RF energy applications at this site with use of a NAVISTAR® THERMOCOOL® quadripolar 4-mm cooled-tip navigation catheter (Biosense Webster). The AT was not eliminated by increasing the set energy levels or applying RF energy deeper into the RAA, and the procedure was terminated because of possible complications.

The patient was given sotalol, which had not been tried before; however, the tachycardia persisted, his symptoms worsened, and his LV ejection fraction decreased to 0.40 (LV end-systolic dimension, 45 mm; LV end-diastolic dimension, 59 mm). We considered epicardial ablation or surgical excision of the RAA. After extensive discussion, we decided to try endocardial ablation once more, this time by means of the cryoballoon ablation technique.

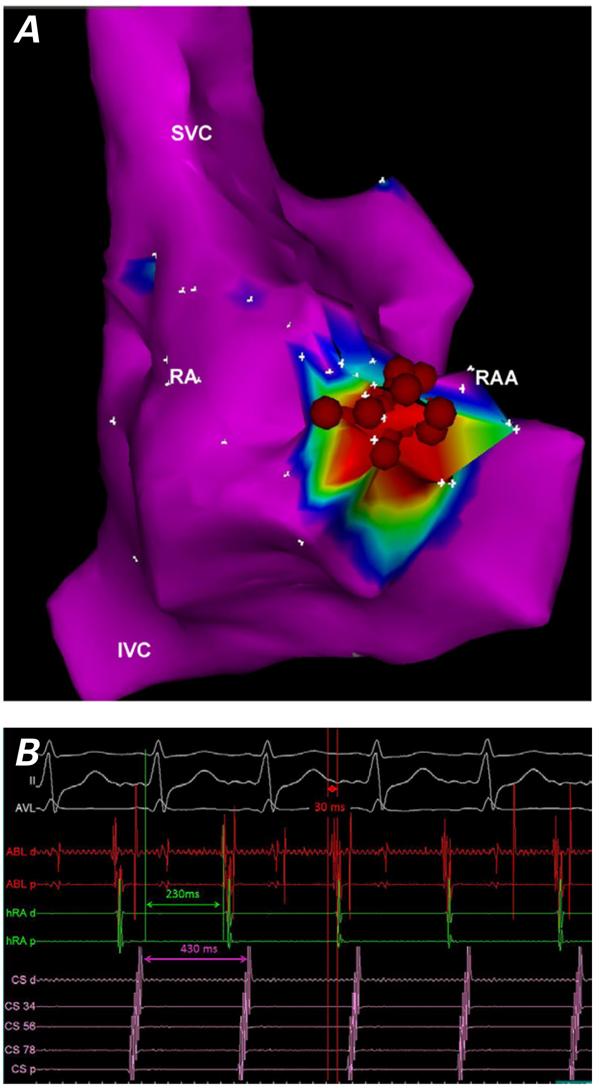

***Fig. 1 A**) CARTO® 3 activation map (right anterior oblique view) shows an eccentric atrial activation from the proximal portion of the right atrial appendage (RAA). **B**) Electrogram shows a tachycardia cycle length of 430 ms and a ventriculoatrial (VA) interval of 230 ms. The earliest local electrogram recorded from the base and mid portion of the RAA precedes the onset of the P wave on electrocardiography by 30 ms.*

ABL = ablation; CS = coronary sinus; d = distal; hRA = high right atrium at the anterolateral wall; IVC = inferior vena cava; p = proximal; RA = right atrium; SVC = superior vena cava

The patient was again taken to the electrophysiology laboratory. A quadripolar diagnostic catheter was placed at the region of the bundle of His, and a decapolar steerable catheter was placed along the posterior wall of the right atrium. A FlexCath® 12F steerable long sheath (Cryocath Technologies Inc.; Kirkland, Canada) was advanced into the RA, and a selective RAA angiogram was obtained. With the guidance of the steerable long sheath, a 28-mm Arctic Front® Cardiac CryoAblation Catheter (Cryocath Technologies) was advanced over a circular Achieve™ Mapping Catheter (Medtronic, Inc.; Minneapolis, Minn) and was placed at the ostium of the RAA. Because the earliest endocardial activation time had been recorded and confirmed at the inferior and posterior base of the RAA during the first 3-dimensionally-guided failed ablation attempt, the balloon was directed primarily to face this particular region. The balloon was inflated and nudged to the RAA, and appropriate positioning was confirmed by means of contrast injection, to avoid displacement further into the RAA. The balloon was directed so that it completely adhered to the inferior basal portion of the RAA. The first attempt at cryoablation, for 240 s at a maximum temperature of –45 °C, was unsuccessful. The curves of the steerable long sheath and the cryoballoon catheter were increased further to improve contact with the inferior and posterior surface of the base of the RAA, where the tachycardia's origin was predicted to be (Fig. 2A). Freezing at this position led to immediate deceleration (up to 750 ms) and termination of the tachycardia in the first minute of the application (Figs. 2B and C). Cryoablation was completed after 240 s at a maximum temperature of –43 °C and was repeated once. After 30 minutes of waiting, the tachycardia was not inducible in the basal state or under pharmacologic stimulation with use of 2 mg of intravenous atropine; in addition, electrical conduction into and out of the RAA was shown, which indicated no electrical isolation of the RAA. In December 2013, the patient's LV dimensions and ejection fraction had returned to normal values (LV end-systolic dimension, 37 mm; end-diastolic dimension, 54 mm; and ejection fraction, 0.61); he was asymptomatic and free of arrhythmias.

Discussion

To our knowledge, this is the first report of the successful focal ablation of an otherwise refractory RAA tachycardia with use of a 28-mm cryoballoon catheter and without isolation of the RAA.

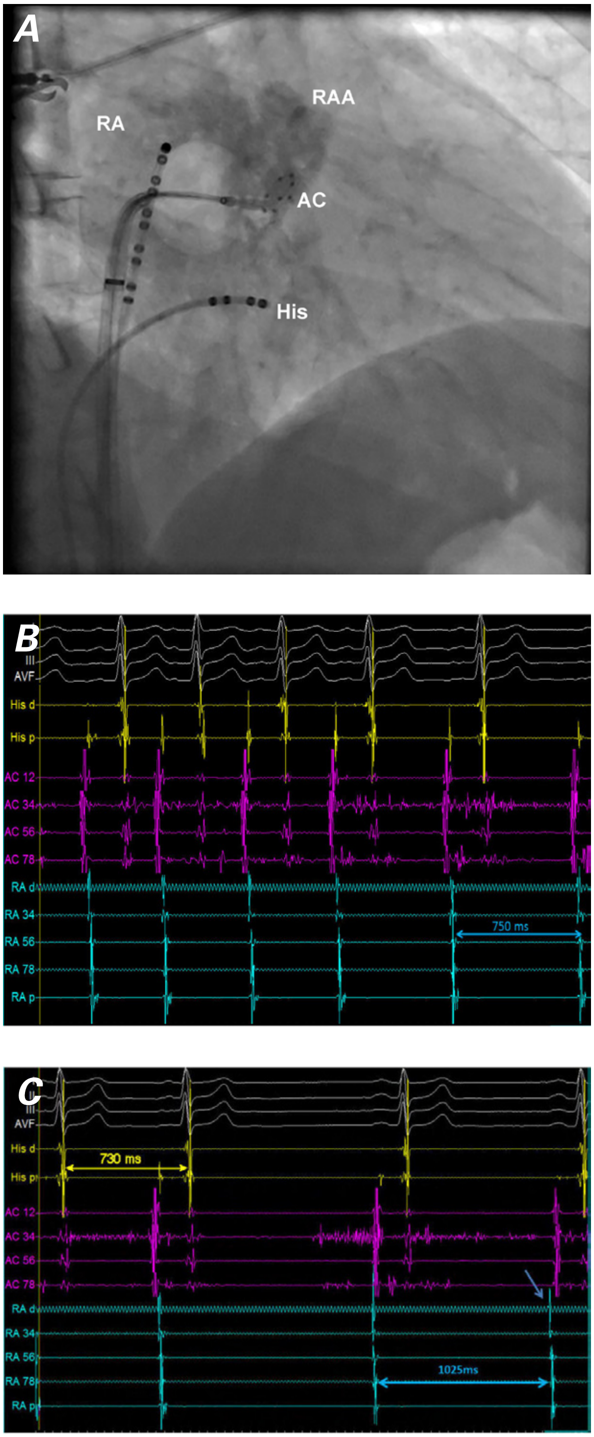

Fig. 2 ***A****) Fluoroscopic image (right anterior oblique view) reveals the cryoballoon catheter's position at the inferior and posterior surface of the base of the right atrial appendage (RAA), the predicted site of tachycardia origin.* ***B****) Electrogram shows immediate deceleration of the tachycardia cycle length up to 750 ms in the first minute of the cryoballoon application.* ***C****) Electrogram shows a 730-ms arrhythmia cycle length before termination (arrow) of the tachycardia.*

AC = circular mapping catheter inside the appendage; d = distal; p = proximal; RA = right atrial catheter along the posterior wall

Supplemental motion image is available for Figure 2A.

Because the anatomy of the RAA is unique and delicate in nature—a trabeculated and smooth-walled vestibule resulting from densely organized pectinate muscles—it impedes catheter manipulation and mapping as well as the precise delivery of effective energy to the desired point. For these reasons, we preferred using the cryoballoon in order to produce more efficient lesions on a larger surface, rather than an alternative approach to apply focal energy point by point until the desired result was achieved. We found only one case, reported by Chun and colleagues,[3] in which a cryoballoon technique was used to ablate RAA tachycardia that was refractory to endocardial and epicardial RF ablation approaches. Our case differs in 2 aspects. First, we wanted to ablate the tachycardic focus without isolating the RAA, to avoid the long-term risks. Conversely, Chun and colleagues did not seek the exact focus of their patient's tachycardia, and instead achieved success by isolating the RAA. The other difference is that we achieved success with use of a 28-mm cryoballoon catheter. We decided to use the 28-mm balloon after selective RAA angiography, because we thought that inflating and freezing the smaller 23-mm balloon deeper inside the RAA would increase the risk of the appendage's perforation and damage to the neighboring coronary vasculature. In contrast, Chun and colleagues initially tried the 28-mm balloon without success; they later tried the 23-mm balloon for better contact with the RAA anterior wall, and they achieved isolation and sinus rhythm. Their patient's RAA had an unusual anatomy (2 discrete lobes), which might be operative in their lack of success with the 28-mm balloon.

Despite its circular and atraumatic structure, the Achieve catheter might cause substantial damage to the surrounding tissues in situations of collapse, especially in regions with a delicate and sensitive anatomy like the RAA. To avoid such complications, frequent injections of opaque material should be made; excessive pressure on the appendiceal wall with the catheter or the sharp tip of the cryoballoon should be avoided; and the distinctive helical structure of the Achieve catheter should be preserved.

Radiofrequency ablation has resulted in high success rates. However, the cryoballoon technique might be an efficient, safe alternative for ablating refractory ATs originating from the RAA and might be considered before undertaking more invasive methods, such as epicardial ablation or surgery. More data and experience are necessary to evaluate the role and safety of this technique in the treatment of refractory ATs that originate from atrial appendages.

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