

Focal Atrial Tachycardia Originating from the Right Atrial Appendage: First Successful Cryoballoon Isolation

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Electrical Isolation of the Right Atrial Appendage Using the Cryoballoon. Focal atrial tachycardias (AT) can arise from the right atrial appendage (RAA). However, conventional catheter mapping and radiofrequency (RF) ablation inside the RAA is associated with the risk of cardiac perforation. The cryoballoon catheter represents a novel ablation device that was originally developed to facilitate pulmonary vein isolation. This report describes the first successful RAA isolation using a cryoballoon in a patient with an incessant focal RAA AT despite previous irrigated tip endo- and epicardial ablation attempts. Further, cryoballoon ablation targets beyond pulmonary veins may evolve. (*J Cardiovasc Electrophysiol*, Vol. pp. 1-4)

catheter ablation, atrial tachycardia, right atrial appendage

Introduction

Focal atrial tachycardias (AT) can originate from various anatomic regions in the heart.¹⁻⁵ Recently, the right atrial appendage (RAA) has been described as a typical but rare site of focal AT origin.⁶ Successful catheter ablation in this anatomic region can be challenging and sometimes requires even surgical RAA excision to eliminate the AT.⁷ Moreover, mapping and RF ablation inside the RAA and its thin wall raises the possibility of cardiac perforation.

Dr. Chun served previously on the European Advisory board of Cryocath. Dr. Kuck reports having received honoraria relevant to this topic.

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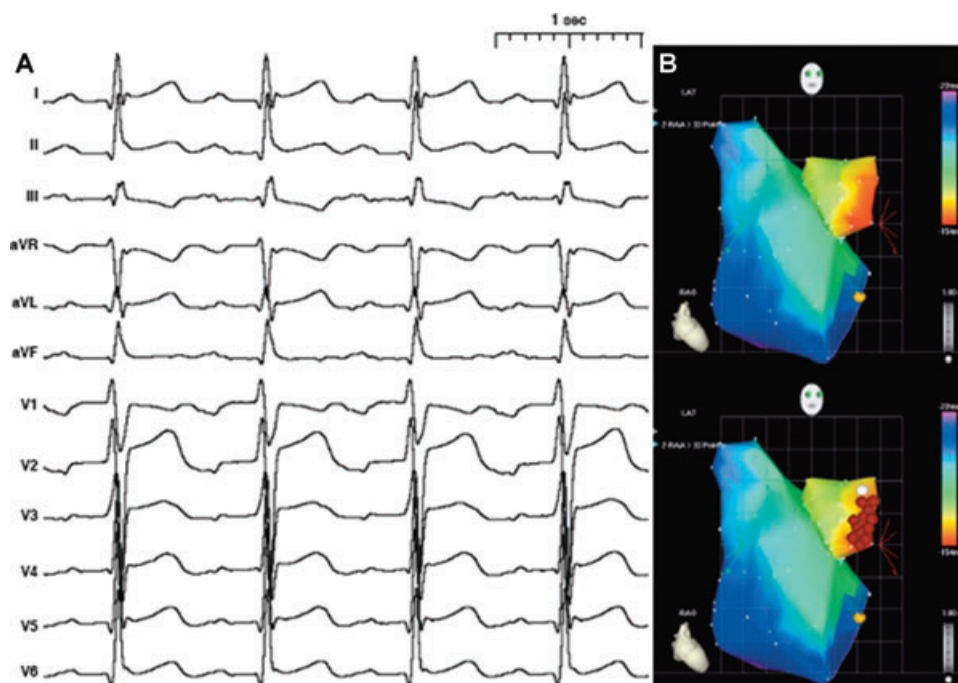


Figure 1. (A) Baseline 12-lead ECG shows AT (heart rate: 120/min) from the RAA. Please note inferior P-wave axis and negative P wave in V1. ST elevation is due to pericarditis after previous epicardial puncture and mapping in the first procedure (details see text). (B) Electroanatomic reconstruction of the RA and RAA performed in the first unsuccessful ablation procedure. Local activation timings indicate focal AT origin from RAA. RAA = right atrial appendage; RA = right atrium; AT = atrial tachycardia. Red dots—sites of irrigated tip ablations, yellow dot—His bundle.

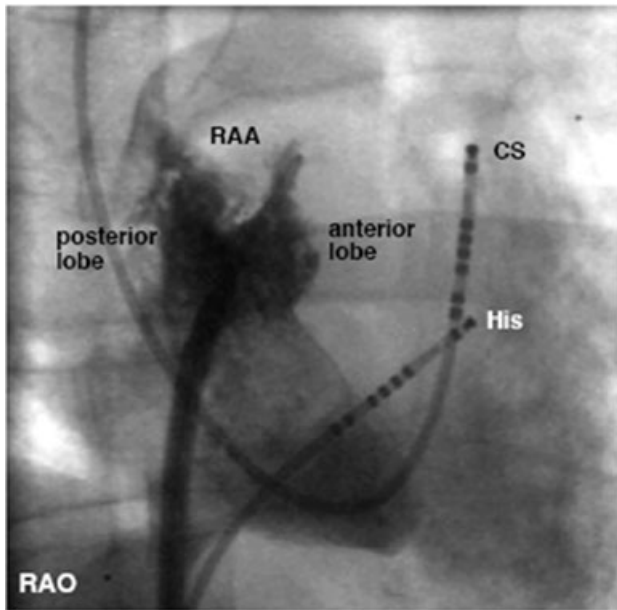


Figure 2. Two portions of the RAA elucidated by contrast angiography (anterior and posterior aspect). RAA = right atrial appendage.

Case Report

A 33-year-old male patient was admitted to our institution for catheter ablation of an incessant AT (heart rate: 120/min, upright P wave in inferior leads and negative P wave in V1–V2, Fig. 1A) despite an antiarrhythmic medication of flecainide and metoprolol after previous slow pathway modulation for AV nodal reentry tachycardia. He complained of massive palpitations, dyspnea, and reduced exertional capacity. The patient had been otherwise healthy lacking a structural heart disease. After informed consent was obtained, the next day a conventional ablation attempt was performed in a fasting state and under sedation with continuous infusion of propofol 1%, as well as boli of fentanyl and midazolam. After placing 6 F decapolar catheters into the coronary sinus and to the His bundle region. Both the right atrium (RA) and the RAA were then

reconstructed (three-dimensional electroanatomic reconstruction system, CARTO, Biosense Webster) using a conventional 3.5 mm tip steerable catheter (NaviStar, Biosense-Webster, Diamond Bar, CA, USA). The tachycardia activation map was in agreement with focal RAA AT origin as the underlying mechanism (Fig. 1B). All local electrograms were recorded using a conventional computerized EP-system (Axiom Sensis, Siemens, Erlangen, Germany). Although a total of 19 RF applications (power: 30 W, target temperature: 43°C, irrigation flow rate: 17 mL/min) were delivered inside the RAA, only transient AT termination could be achieved. Moreover, as previously described,⁸ we punctured the epicardial space but, in spite of extensive epicardial mapping, no favorable local activation timings could be obtained; thus, no RF application was delivered.

A second ablation procedure was scheduled after 2 days to use the Cryoballoon catheter (Arctic Front, Cryocath, Montreal, Quebec, Canada). Cryothermal (CT)-energy deployed via a balloon catheter represents a novel ablation strategy that was developed to facilitate pulmonary vein (PV) isolation. The cryoballoon catheter consists of two balloon layers and is available in either 23 mm or 28 mm diameter. The refrigerant N₂O is delivered into the inner balloon where it undergoes a liquid to gas phase change resulting in inner balloon cooling temperatures of <80°C. Six F decapolar catheters were placed into the coronary sinus and at the His bundle region. The steerable sheath (12 F) was introduced from the right femoral vein and advanced to the RA. A selective RAA angiography displayed two RAA lobes (one anterior, one posterior lobe, Fig. 2). Using the “over the wire” technique, the 28 mm balloon was advanced to the RAA, inflated and further pushed to occlude the base of the anterior RAA section. Occlusion angiography revealed minor contrast leakage at the anterior aspect of the RAA that resulted in incomplete anterior electrical isolation. Despite 16 CT applications (duration: 240 seconds), again only transient AT termination was achieved. A 12 mm Lasso catheter (Biosense Webster) was placed inside the RAA and used to evaluate RAA-RA conduction and documented transient RAA isolation (RAA-RA dissociation) with subsequent sinus rhythm (SR). However, conduction recovery resulted in immediate AT recurrence. To close the recovered anterior gap we switched to the smaller cryoballoon (23 mm) and then obtained perfect anterior RAA occlusion (Fig. 3). Application of CT energy at this site resulted in immediate AT termination and change to sustained SR (Fig. 3). RAA Lasso recordings

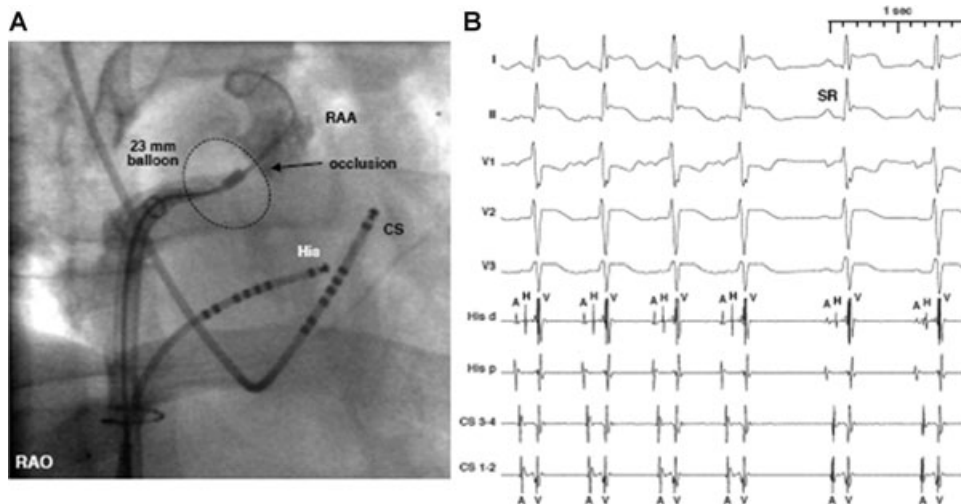


Figure 3. (A) Complete balloon occlusion (23 mm) of the anterior lobe of the RAA. (B) Subsequent AT termination to SR (B). AT = atrial tachycardia; SR = sinus rhythm; RAA = right atrial appendage; CS = coronary sinus catheter; His = His catheter.

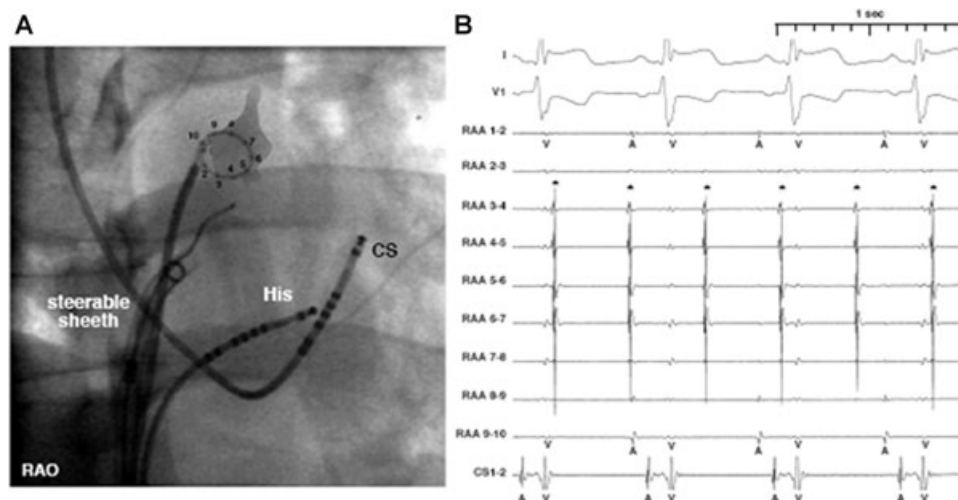


Figure 4. (A) Lasso catheter (Biosense Webster, 12 mm) positioned in the RAA (3–4 to 7–8) and in the RA (1–2 to 3–4 and 8–9 to 9–10). (B) Complete electrical RAA-RA dissociation. The anterior ring electrodes (3–4 to 7–8) show incessant AT inside the RAA (*) whereas more posterior electrodes positioned in the RA show dissociated SR (1–2 to 3–4 and 8–9 to 9–10). A = atrium; AT = atrial tachycardia; RAA = right atrial appendage; SR = sinus rhythm; V = ventricle.

now proved sustained complete electrical RAA-isolation (RAA-RA dissociation with unchanged AT inside the RAA (Fig. 4A,B). The postprocedural course of the patient remained uneventful and he was discharged without any complications in stable SR for a follow-up of 180 days.

Discussion

In this patient, macroreentry as the underlying AT mechanism was excluded based on the clinical and electrophysiologic findings. Automaticity was most likely responsible for this focal RAA AT that was in agreement with the three-dimensional electroanatomical map. The RAA has been identified as a rare but typical site of focal AT origin accounting for approximately 3.8% of all focal AT.⁶ Catheter ablation within the RAA with its pectinated, smooth-walled vestibule⁹ and low blood flow is complicated by the fact that this structure does not allow easy catheter manipulation and mapping. Moreover, the thin nature of the atrial appendage raises the possibility of easy cardiac perforation¹⁰ due to catheter manipulation. Therefore, catheter manipulation and mapping, especially in distal RAA sites, is potentially dangerous. As it was performed in the first ablation attempt, irrigated tip ablation is certainly required in this cardiac region to ensure adequate power delivery with a reduced risk of impedance and temperature rise and subsequent steam pop.

However, as in this patient, RAA AT often is incessant⁶ and may result in tachycardia-induced cardiomyopathy.⁶ Therefore, an assertive therapeutic approach is clearly warranted. Mizui *et al.* reported a patient with an incessant RAA AT and failed catheter ablation in which finally the appendage had to be surgically removed.⁷

Delivery of CT energy has been shown to be safe and to successfully eliminate cardiac arrhythmias in human.¹¹ Recently, the cryoballoon has been introduced in the field of catheter ablation of atrial fibrillation to accomplish the challenging endpoint of PV isolation. Neither PV stenosis nor thrombolism has yet been observed. In our patient, the distal RAA AT focus could not be reached with an irrigated RF ablation catheter and ablated despite endo- and epicar-

dial mapping attempts. In analogy to PV isolation using the cryoballoon, we hypothesized that the cryoballoon might occlude the RAA and, therefore, overcome these problems by covering and attaching more proximal RAA sites to achieve complete electrical isolation (Fig. 4B). However, one has to be aware that the tip of the cryoballoon is rigid and also requires gentle manipulations in such a delicate region of the heart as the RAA.

Conclusion

This report describes first successful electrical isolation of the RAA using the novel cryoballoon. Further cryoballoon ablation targets beyond pulmonary veins may evolve.

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