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Cryoballoon ablation of focal atrial tachycardia originating from right atrial appendage: Case report and review of the literature

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ABSTRACT

The right atrial appendage (RAA) is a rare site of focal atrial tachycardia (AT). Sometimes, catheter ablation cannot successfully be accomplished at this location due to the difficulty in reaching the exact ablation site as well as the associated possible life-threatening complications like pericardial tamponade or perforation. Although radiofrequency (RF) ablation is preferred for the treatment of RAA tachycardias, alternative tools may be required in rare instances. This report presents a case of RAA tachycardia that was not terminated by RF ablation, instead, has been successfully ablated using cryoballoon. In addition, an overview of the literature and therapeutic options for the AT originating from RAA have also been included.

1. Introduction

The right atrial appendage (RAA) is a relatively rare site for focal atrial tachycardia (AT). On comparing other tachycardias, those originating from RAA are more likely to be observed in younger male patients, more frequently incessant, and associated with more frequent left ventricular dysfunction, which also highlights the importance of curative ablation procedures in such cases [1]. However, successful catheter ablation in this anatomic region can be difficult. Moreover, mapping and radiofrequency (RF) ablation within the thin-walled RAA pose a risk of perforation and cardiac tamponade. In rare cases, surgical excision of the RAA may be required in order to eliminate the AT. This report aims to describe a successful RAA tachycardia ablation using cryoballoon in a young patient having tachycardiomyopathy with failed RF ablation. In addition, a review of the literature on RAA tachycardia ablation has also been included.

2. Case report

A 26-year-old male patient with a history of previously failed AT ablation was referred for catheter ablation. The patient complained of exertional dyspnea with no palpitation for the last two months. Physical examination was unremarkable except for the presence of pectus excavatum. Electrocardiography revealed frequent episodes of AT occurring at a rate of 160 bpm (panel A). Transthoracic echocardiography revealed a decreased left ventricular ejection fraction (LVEF) (25%), dilated left ventricular diastolic diameter (63 mm), minimal pericardial effusion, and moderate-to-severe mitral regurgitation (panel B). The results of laboratory tests, including thyroid function, were found to be normal. The patient developed an allergic reaction to amiodarone, after which the anti-arrhythmic medications were stopped. The clinical condition of the patient was interpreted to be tachycardia-induced cardiomyopathy and thus, catheter ablation was planned again.

After placing the catheters at the coronary sinus, the bundle of His, and high right atrium area, the basal measurements were made in sinus rhythm with an AH of 95 msec and HV of 40 msec. Tachycardia was induced spontaneously. The Decapolar catheter in coronary sinus revealed a similar concentric atrial activation sequence with sinus rhythm being the earliest activation in the proximal poles (tachycardia cycle length of 330 msec). A three-dimensional electro-anatomic mapping system (CARTO) and Navistar® Thermocool® quadripolar 3.5 mm cooled-tip navigation catheter (Biosense Webster, a Johnson & Johnson company; Diamond Bar, CA) were used to map the tachycardia. Activation mapping demonstrated that the earliest local electrogram (~40 msec) was recorded at the anterosuperior portion of the RAA (panel C and

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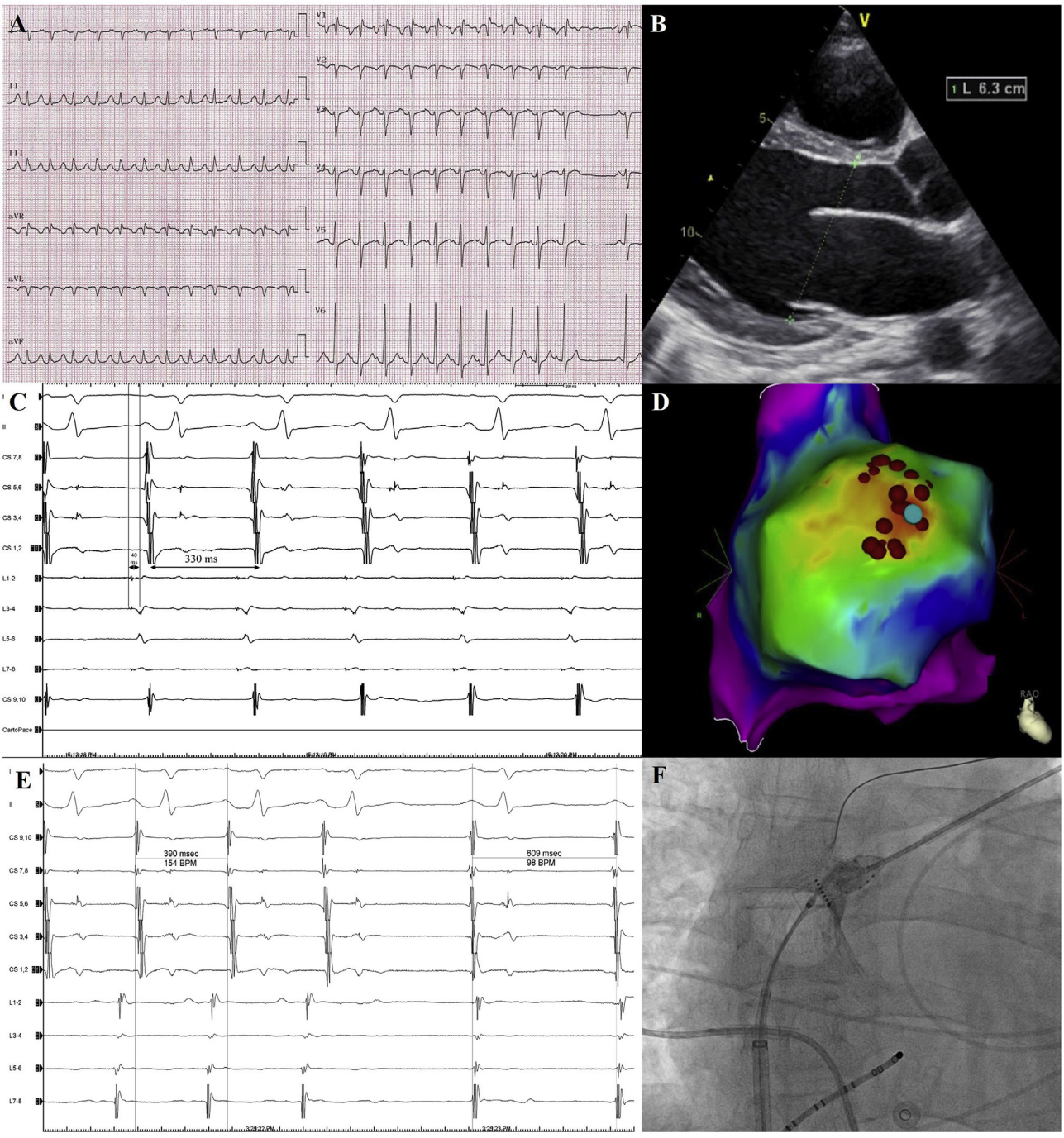

Fig. 1. Panel A: Electrocardiogram (ECG) showing a long RP tachycardia at 160 beats/min. **Panel B:** Increased left ventricular diameter due to tachycardiomyopathy. **Panel C:** Intracardiac ECG showing the tachycardia cycle length of 330 msec. "L" indicates the lasso catheter in the right atrial appendage (RAA). The earliest local electrogram recorded from the anterosuperior portion of the RAA precedes the onset of the P wave on electrocardiography by 40-msec. **Panel D:** Activation map (right anterior oblique view) showing early atrial activation in the RAA. **Panel E:** Intracardiac EGMs showing tachycardia termination during cryoballoon ablation. It is observed that the cycle length is prolonged just before tachycardia terminates (330 msec vs 390 msec). **Panel F:** Anteroposterior fluoroscopic image revealing the position of 28 mm cryoballoon catheter. Leakage from the inferior part of the RAA was observed after contrast injection from the tip of the catheter.

D). However, tachycardia could not be terminated with multiple RF ablation attempts. Due to the possible risk of complications involved, the cryoballoon catheter was preferred for the isolation of the RAA. A 12 F steerable long sheath (FlexCath, Cryocath Technologies Inc.; Kirkland, Canada) was advanced into the RA, and a selective RAA angiogram was performed using a pigtail catheter. With the guidance of the steerable long sheath, a 28-mm cryoballoon catheter (Arctic Front, Cryocath, Montreal, Quebec, Canada) was then advanced over a circular mapping catheter (Achieve, Medtronic, Inc.; Minneapolis, MN) and placed at the ostium of the RAA. However, the cryoballoon could not completely occlude the RAA ostium and a contrast leak was observed from the inferior part of the RAA ostium during occlusion (panel F). Since the earliest endocardial activation time was recorded at the anterosuperior part of the RAA on activation mapping, the balloon was directed primarily to the surface of this region. The balloon was

inflated and attached to the inside of RAA. The appropriate positioning was confirmed by contrast injection. Although the tachycardia was terminated at the first attempt by cryoballoon ablation (nadir temperature of −47 °C), yet, it recurred shortly after deflation. After the cryoballoon established a good contact at the anterosuperior surface of the RAA, tachycardia was terminated and sinus rhythm was accomplished again (freezing cycle 300 sec with a nadir temperature of −48 °C) (panel E). An additional bonus freezing (240 msec) was applied at the same site. After cryoablation, tachycardia was non-inducible with programmed atrial and ventricular stimulation. The tachycardia was non-inducible even under isoproterenol infusion after 30 min of the post-ablation waiting period. The patient was discharged the next day after the catheter ablation procedure. The stay of the patient at the hospital was uneventful. During the first month follow-up, the patient was on sinus rhythm (65 bpm) with no anti-arrhythmic therapy. Control echocardiography revealed an improvement of 45% in the LVEF and a decrease in the severity of mitral regurgitation.

3. Discussion

Radiofrequency ablation is known as the 'cornerstone' for several cardiac arrhythmias. However, it is not free of complications including increased risk of cardiac perforation or thromboembolism. In addition, RF ablation has limited effectiveness in the areas of low blood flow such as coronary sinus or atrial appendages, which may cause char formation or steam pop formation on the catheter tip. Although irrigated catheters can be used in such cases, it is not easy to access and position the ablation catheter at every anatomical site or to keep it in a stable position at the desired area. These limitations are particularly relevant for RAA that has pectinate muscle and smooth-walled vestibule, thus making catheter manipulation and mapping more difficult. Moreover, the thin-walled structure of the atrial appendage increases the chances of cardiac perforation during mapping and ablation procedure [2].

The patient had focal AT originating from the RAA, which was the most possible diagnosis that was also demonstrated in the electro-anatomical mapping. The RAA is a rare location for right atrial AT, accounting for approximately 3.8% of all focal ATs. Previous studies have reported successful results with RF ablation in ATs originating from RAA [3]. However, catheter ablation of focal RAA tachycardia using RF energy is sometimes associated with recurrences, just like that seen in this patient. The unique and delicate nature of RAA may impede catheter manipulation and mapping as well as the precise delivery of effective energy to the desired point. Alternative approaches including surgical excision and epicardial RF ablation are much more invasive. Although the magnetic navigation system is an alternative option in such cases, limited availability and possible complications are important concerns. RAA is a highly mobile structure which limits consistent catheter contact during ablation, even with a steerable sheath. To overcome this problem, Roshan et al. employed a focal cryoablation catheter and successfully eliminated the RAAT [4]. In contrast to RF ablation where the catheter remains mobile during ablation, solid tip cryoablation provides a freeze-mediated catheter adhesion to the target tissue. Focal cryoablation, particularly in tachycardias originating from the apex of the RAA, seems to be a promising method in terms of safety and effectiveness.

Although most focal tachycardias can be successfully ablated using either RF or cryo-catheters, a larger and deeper lesion may be needed, especially in the basal portions of the RAA. Moreover, the cryoballoon catheter can create a larger lesion, with a very stable catheter position because of direct contact of the tissue with the hemispheric surface of the cryoballoon. Previously, Chun and his colleagues ablated an RAA tachycardia using a 23-mm cryoballoon; however, the RF ablation attempts failed [5]. They completely isolated the RAA from the rest of the right atrium without defining the exact focus of tachycardia. Additionally, Amasyali et al. also reported a successful ablation of RAA tachycardia originating from the infero-basal part of RAA using a 28-mm cryoballoon [1]. Diversely, RAA tachycardia was terminated by direct contact of the surface of the cryoballoon rather than by the isolation of RAA. In the present case, however, the anterosuperior ridge region was found to be the focus of tachycardia, on comparing it with previous reports. Tachycardia was also terminated by direct contact of the cryoballoon to the origin of tachycardia rather than isolation. The ablation success using cryoballoon was presumed to be due to the homogenous, deeper and larger lesion formation attained by the freezing hemisphere of cryoballoon catheter.

In conclusion, this report highlights the usefulness of the cryoballoon catheter for ablation of RAA tachycardia as an alternative therapeutic option that might obviate unnecessary and harmful RF ablative attempts or even more invasive approaches.

Conflicts of interest

None.

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None.

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