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Entrapment of focal atrial tachycardia using cryoballoon ablation; Sinus rhythm in the left atrium and ongoing atrial tachycardia in the left atrial appendage

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ABSTRACT

Left atrial appendage (LAA) is a well-known source of focal atrial tachycardias (AT). Although radio-frequency (RF) energy is the most commonly used technique in such cases, there was an option other than epicardial approach when RF technique fails. Cryoballoon technology is primarily developed to be used for pulmonary vein isolation (PVI). Also, there was no report regarding the isolation of LAA by using cryo-balloon in patients with focal AT. In this case, for the first time in the literature, we successfully isolated the LAA because of failed attempts of RF ablation for focal AT in whom the surface electrogram showed a sinus rhythm while arrhythmia continues inside the LAA.

1. Introduction

Left atrial appendage (LAA) is an already known source of focal atrial tachycardias (AT) [1,2]. While radio-frequency (RF) energy based focal ablation of these arrhythmias was reported to be successful in previous studies, there was a gap in literature what to do in case of unsuccessful endocardial focal RF attempts. An epicardial approach is an alternative option when endocardial ablation of LAA fails [2]. Moreover, cryo-balloon based LAA isolation may be considered by electrophysiologists before epicardial access [5]. Although there was only one case with focal AT regarding the cryo-balloon based ablation of the right atrial appendage [4], to the best of our knowledge, no report was present with the cryo-balloon based ablation of LAA originated focal AT. Thus, we aimed to report our unique patient with focal AT in whom focal application of RF energy was unsuccessful and cryo-balloon based LAA isolation entrapped the arrhythmia into the LAA and convert our patient to the sinus rhythm.

2. Case description

A 22-year-old male patient admitted to our department with the complaints of dyspnea and incessant palpitations for 2 years. Previous medical history revealed successful left lateral accessory pathway ablation 3 years ago without any structural heart disease. The 12-lead electrocardiography demonstrated long RP tachycardia with a negative P wave morphology in DI and aVL, positive P wave morphology in inferior leads and positive P wave in V_1 derivations. The procedure was performed under deep conscious sedation. Using femoral veins, diagnostic catheters were placed into the high right atrium and coronary sinus. The coronary sinus mapping revealed a distal-to-proximal atrial activation sequence pattern during the AT (cycle length: 540 msec); therefore left atrial mapping was planned. After transseptal puncture, a 15-mm spiral map catheter (Lasso, Biosense-Webster Inc., Diamond Bar, CA, USA) was placed into the left atrium. Using Carto3® and CONFIDENSE™ Module (Biosense Webster, Inc.), approximately 2000 points were achieved which revealed earliest atrial activation inside the left atrial appendage (LAA) (Fig. 1A, Suppl file 1). Afterwards, an irrigated tip 3.5 mm ablation catheter (Thermocool SF, Biosense Webster, Diamond Bar, CA, USA) was introduced to the earliest point in the LAA, where local atrial activation was 33 msec earlier than the distal coronary sinus activation and RF energy was given with 25 W which did not terminate the tachycardia despite multiple attempts. As a result, we decided to isolate LAA using a second

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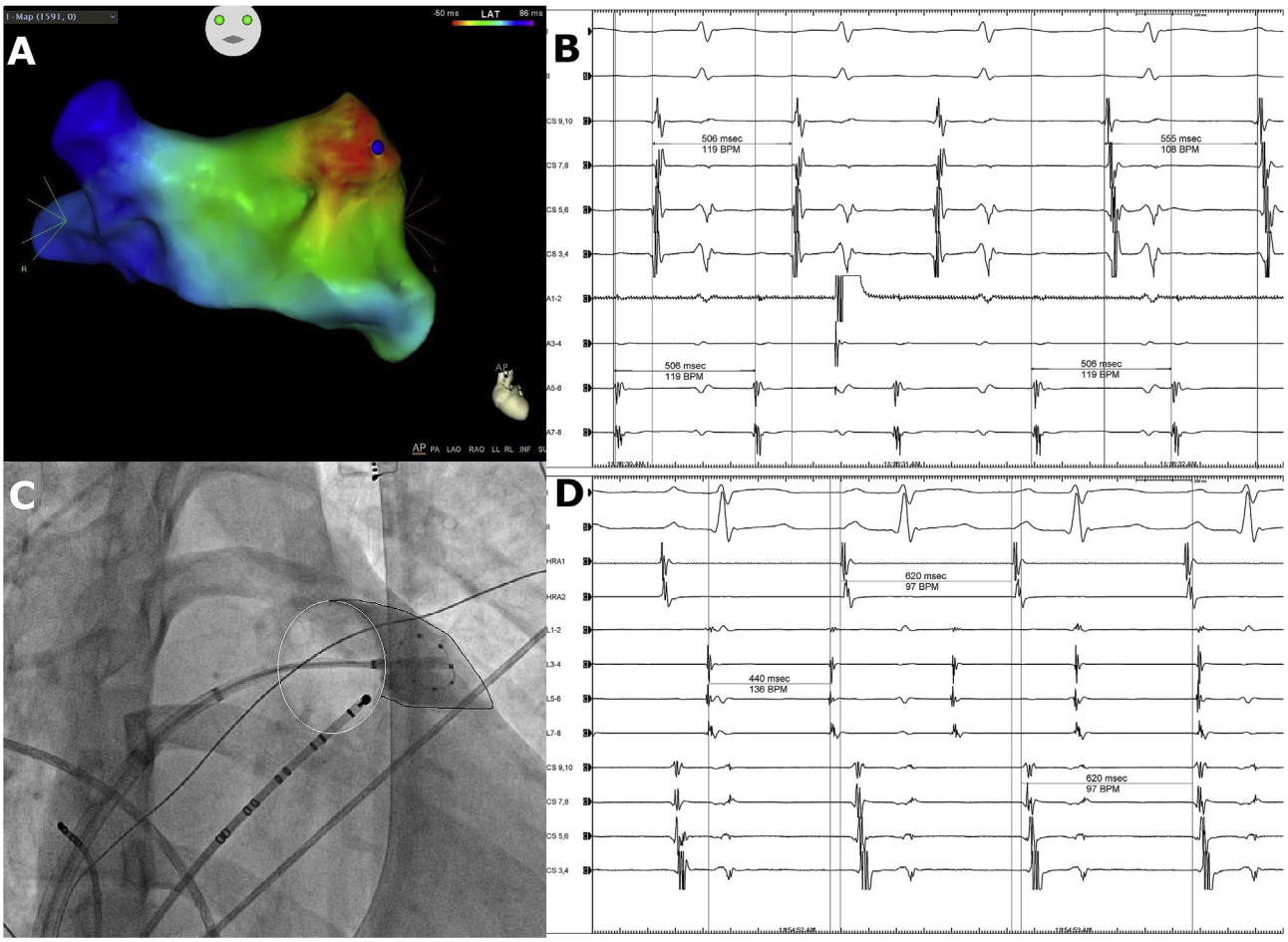

Fig. 1. (A) CARTO map demonstrating earliest activation in the distal portion of LAA. (B) Simultaneous recordings of the left atrial appendage and coronary sinus catheter in the patient with ongoing AT. Intracardiac electrograms showed atrial tachycardia with the earliest activation in the distal CS tachycardia (cycle length: 540 msec) which was conducted to the left atrium (cycle length: 540 msec) and map catheter inside the LAA had the earliest atrial activation. (C) Fluoroscopic image of the CB ablation of LAA. (D) Termination of tachycardia in the left atrium and change in the activation pattern of coronary sinus catheter despite the ongoing tachycardia in the LAA. Dissociated AT originating from the LAA (arrows) during sinus rhythm in the rest of the atrium (cycle length: 620 msn).

generation 28-mm cryo-balloon (CB2; Arctic Front Advance, Medtronic, USA). After placing the inner lumen circular map catheter (Achieve 15mm, Medtronic Inc., Minneapolis, USA) into the LAA, CB was inflated and complete LAA occlusion was confirmed after contrast injection (Fig. 1B, Suppl file 2). The left phrenic nerve (PN) was constantly paced from the LAA using circular mapping catheter throughout the freezing cycle with 2000 msec cycle length and a 12 mA output. The PN capture was assessed by intermittent fluoroscopy and tactile feedback obtained from the patient's abdomen. During CB ablation, coronary sinus activation pattern turned into a concentric activation pattern and sinus rhythm was achieved, whereas AT was ongoing in the LAA [time to block, 140 s; CB temperature, −53 °C (Fig. 1C&D). CB freeze was limited to 240 sec, reaching a minimum temperature of −55 °C. Coronary angiography just after LAA isolation revealed no vasospasm at left Cx artery. 30 minutes after the LAA isolation, adenosine challenge test was performed in order to exclude dormant conduction. After adenosine bolus administration, AV block and simultaneous termination of AT was observed (Fig. 2A); however, resumption of AT in the LAA was observed a few seconds later despite sinus rhythm in the LA (Fig. 2B). Oral anticoagulation with rivaroxaban 20 mg was initiated on the same day of the procedure. The postprocedural course was uneventful and transesophageal echocardiography (TEE) on the following day revealed no reduction in LAA flow velocity and thrombus formation. At the 3rd-month control visit, asymptomatic patient was in sinus rhythm and no thrombus in the LAA at control TEE. Thus, it was recommended him to discontinue both antiarrhythmic and anticoagulant agents.

3. Discussion

In this patient, enhanced automaticity was the most likely mechanism for this focal AT originating from the LAA. Both 3D map characteristics and response to adenosine challenge test as well as the immediate resumption of the tachycardia in the LAA were consistent with the automatic nature of this focal tachycardia. LAA is an uncommon but important site for focal AT. Previous studies reported successful results with RF ablation in ATs originating from either endocardial or epicardial site of LAA [1,2]. However, as LAA is composed of the thin-walled myocardium, RF applications in the LAA might cause potential complications like perforation, left PN palsy (PNP) or steam pop formation [3]. In our case, RF delivery was unsuccessful despite multiple energy deliveries to the earliest recorded point with irrigated tip ablation catheter. Failure of endocardial LAA ablation in focal ATs might be due to several factors including anatomic properties of LAA, thick pectinate muscles or epicardial location of AT. Because of the lack of a completely negative unipolar signal in the earliest LAA point in the endocardial

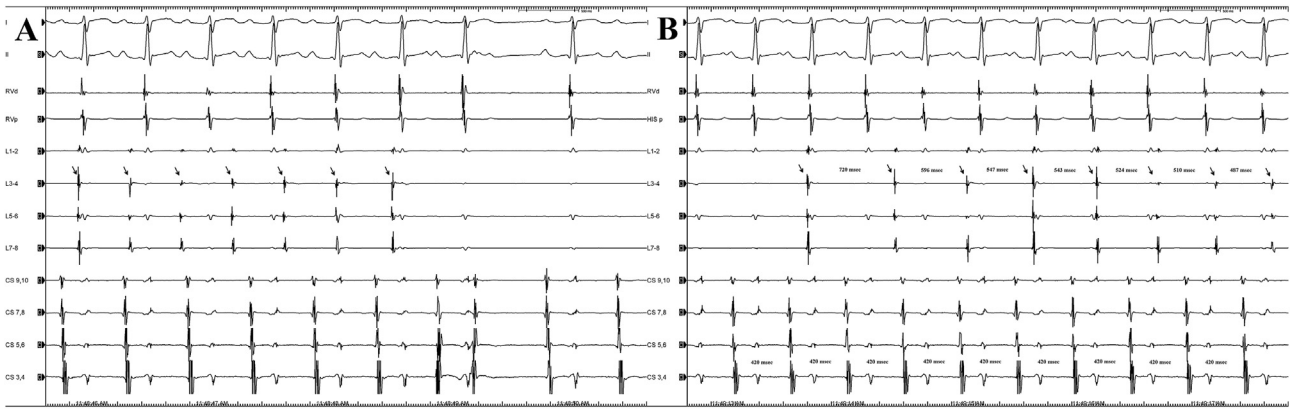

Fig. 2. Intravenous adenosine (30 mg) was given after the CB isolation of LAA in order to determine the dormant conduction. Adenosine terminated LAA tachycardia as well as the AV conduction (asterisk). After the end of adenosine effect, LAA tachycardia resumes again with a cycle length of 540 msec, whereas the rhythm was sinus in the rest of the atrium.

site of our patient, isolation of the LAA from the remaining LA was planned before proceeding to epicardial ablation.

Isolation of PVs using CB is a preferred method especially in case of ATs originating inside the PVs. In addition, isolation of right atrial appendage for focal ATs was reported previously; however, treatment of focal AT originating from LAA using CB has not been described before [4]. The logic behind the CB isolation of LAA for this focal AT lies on the fact that complete encircling of the LAA ostium with CB can dissociate the AT from the rest of LA. Nevertheless, LAA isolation entrapped the AT inside the LAA and adenosine test after the procedure did not reveal any dormant connection. Recent studies reported inconsistent results after LAA isolation in persistent AF using RF energy regarding the thromboembolic adverse events. On the other hand, Canpolat and colleagues [5] reported favorable results without an increased risk for thrombus formation using CB for LAA isolation. However, CB based LAA isolation is not free of complications like left PNP and left Cx artery spasm. The left PN should be constantly paced from the LAA using circular mapping catheter throughout the freezing cycle to prevent left PNP and PN capture should be assessed by intermittent fluoroscopy and tactile feedback obtained from the patient's abdomen [6]. A rare but interesting observation which was not reported during LAA isolation with RF energy was left Cx artery spasm that was observed in 4% of patients in our recent study [6]. When the anatomic proximity of Cx to the LAA orifice was considered, injury to the Cx artery should also be kept in mind especially in case of lower nadir temperatures during CB ablation of LAA. Left coronary angiography may be performed simultaneously or after the LAA isolation to exclude the left Cx artery vasospasm in subjects undergoing LAA isolation. Moreover, gentle manipulation of CB and inner lumen circular mapping catheter are needed in order to prevent LAA perforation. In our patient, we did not observe any complications or thrombus on the day after the procedure and during the 3rd-month follow-up. Because of different types of LAA morphology among patients like a fingerprint, current CB technology may not fit at all LAA with various shapes and sizes.

In conclusion, to the best of our knowledge, this is the first case report of AT originating from LAA and describing the use of CB for the isolation of LAA. This report also highlights the use of CB based LAA isolation as an alternative therapeutic option which might obviate unnecessary and harmful RF ablative attempts or epicardial approach. However, the potential complications due to both maneuverability of the CB catheter and potential thromboembolic complications after the procedure should be kept in mind by the operators.

Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.ipej.2017.10.006.

Conflict of disclosure statement

There is no conflict of interest related to our manuscript and was not supported by any grant or institution.

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