First successful ablation of atrial tachycardia from right atrial appendage using circular pulse field ablation catheter

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Abstract

Introduction: Atrial tachycardia(AT) occurring from the right atrial appendage(RAA) is relatively uncommon, while the catheter ablation is complicated by the anatomic characteristics. **Methods:** We reported a case of 60-year-old male patient who was admitted with incessant AT. **Results:** The tachycardia activation mapping demonstrated that the AT originated from the tip of RAA. Pulsed field ablation(PFA) using the circular mapping&PFA catheter terminated AT without any complication. **Conclusions:** This case corroborates that PFA might be an alternative strategy for ablation of atrial arrhythmia originating from the atrial appendage.

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Short-title: Fulse field ablation of focal AT from RAA

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Conflict of interest:

The authors declare no conflict of interest.

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Keywords: atrial tachycardia; right atrial appendage; pulse field ablation

Introduction

Atrial tachycardia(AT) occurring from the right atrial appendage(RAA) is relatively uncommon, with a proportion of approximately 8% among all focal AT patients[1]. Nevertheless, right atrial appendage tachycardia(RAAT) is not easily terminated and is commonly associated with tachycardiomyopathy, whihe the catheter ablation of RAAT is complicated by its anatomic characteristics. Hereby, we presented a case of incessant AT which was termintaed by pulse field ablation(PFA) using circular PFA catheter.

Case presentation

A 60-year-old male patient complained with persistent palpitations and chest tightness for two months. He was prescribed with metoprolol after being diagnosed with "inappropriate sinus tachycardia" in other hospitals. However, it did not work and he was admitted to our department for further treatment. The 24-hour Holter electrocardiogram(ECG) showed incessant AT, presenting with mean heart rate of 124bpm. As shown in the baseline 12-lead ECG(Figure1A), low-amplitude positive P-wave can be observed in leads I, II, and avF, while negative P wave in avR and V1 leads. Accordingly, it indicated that AT originating from RAA should be taken into consideration. After informed consent was obtained, the tachycardia activation mapping using three-dimensional electroanatomic reconstruction system(CARTO, Biosense Webster) and a conventional 3.5 mm tip steerable catheter (NaviStar, Biosense Webster, CA, USA) confirmed that the AT originated from the tip of RAA. A conventional radio frequency ablation attempt (power: 30 W, target temperature: 43*C, irrigationflow rate: 17 mL/min) was performed but failed to eliminate AT. Given that the potential risk such as cardiac tamponade and invalid conventional ablation of RAA, we decided to use PFA catheter for second ablation after thorough communication with the patient.

After signing the informed consent form, the second ablation procedure was performed using the circular mapping&PFA catheter(Jinjiang Electronic Medical Equipment Co., Ltd. PRC). Both the right atrium and the RAA were reconstructed. The AT activation mapping was in agreement with RAA origin(Figure 2). During the mapping process in the RAA, the AT could terminate spontaneously and sinus rhythm was restored transiently. Moreover, the earliest activation point of the focal RAA-originated AT was away from sinus node mapped during sinus rhythm. Four electrodes of the circular mapping&PFA catheter, which located at the earliest activation site, were selected for PFA using 1800Volts, 480μs. The AT was terminated at the first attempts(Figure 3). A total of three overlapping applications were delivered. No AT can be induced by burst atrial pacing or isoproterenol administration. The substrate remapping after ablation showed that only a small area of low voltage at the tip of RAA was observed. No complications occurred. Acute procedural success was achieved as shown in the post-ablation 12-lead ECG(Figure 1B). At one-month follow-up, the patient was free of ATs and atrial premature beats.

Discussion

The focal AT occurring from the RAA is relatively uncommon, while the catheter ablation is complicated by the anatomic characteristics. The thin nature of RAA raises the risk of cardiac perforation during catheter ablation, especially in the apex of RAA. Traditional catheter ablation using radiofrequecy energy is always difficult to achieve a target temperature due to the fact that the pectinate component of the RAA does not allow energy infiltration into the AT focus. Thus, therapeutic options for ablation within RAA has been extensively investigated. Previous study suggested that irridated-tip catheter might be helpful for these patients[2]. The combination of catheter ablation and video-assisted thoracoscopic atrial appendectomy has also be considered effective to manage focal AT from RAA[3]. Compared to this more invasive approach, cryoballoon ablation has been found to be an alternative therapeutic strategy that might obviate unnecessary and harmful radiofrequency ablative attempts[4, 5]. However, it should be noted that the tip pf the cryoballoon is rigid and can lead to more extensively inaccurate lesion. Recently, Lukas Urbanek et al reported a case of an incessant AT arising from RAA that successfully treated with pulsed field ablation using four electrodes of 31-mm FARAWAVE catheter[6].

In this case, circular PFA catheter was firstly used for mapping and ablation of focal AT from RAA. It has been shown to be safe and successfully eliminate AT at the first attempts within 3s. PFA has been recently introduced for PV isolation in atrial fibrillation patients[7]. It is a nonthermal ablative modality which can destabilize cell membranes and preserve extracelluar matrix by forming irreversible nanoscale pores and leakage of cell contents, culminating in cell death. Notably, specific characteristic threshold field strengths could be observed in various tissues, with the lowest threshold values in cardiomyocytes. This myocardial specificity could potentially limit collateral damage of adjacent tissue and avoid post-ablation complications. PFA within RAA can reduce the risk of pericardial tamponade caused by atrial appendage rupture due to RFA or cryoballoon ablation. In addition, a deeper ablation lesion can be achieved by PFA than traditional energy, which can lead to effective elimination of deep lesions in the pectinate muscle of RAA. The ablation procedure of PFA is often accomplished within milliseconds or even shorter, which greatly shortens the operation time and further reduces the risk of complications. Thus, for ablation of special structures such as the atrial appendage, PFA seems safer and more effective than RFA or cryoablation. It can be concluded that PFA might be an alternative strategy for ablation of atrial arrhythmia originating from the atrial appendage. Further research is needed to confirm our findings.

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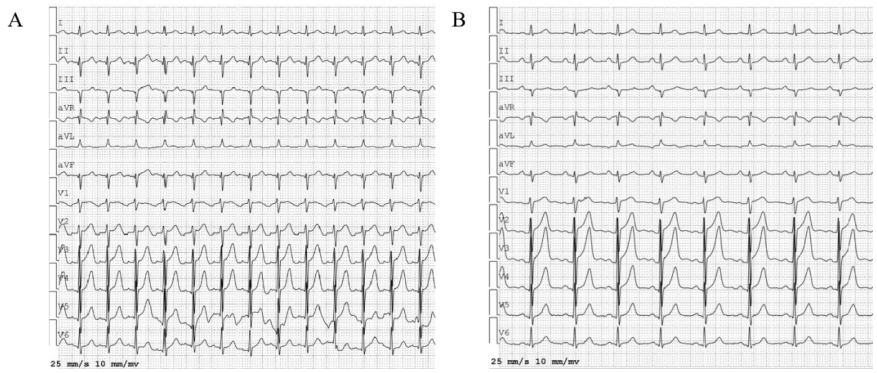

Figure 1. (A) Baseline 12-lead ECG shows AT from the RAA(135bpm); (B) Post-ablation 12-lead ECG shows sinus rhythm(86bpm). AT:atrial tachycardia; RAA: right atrial appendage.

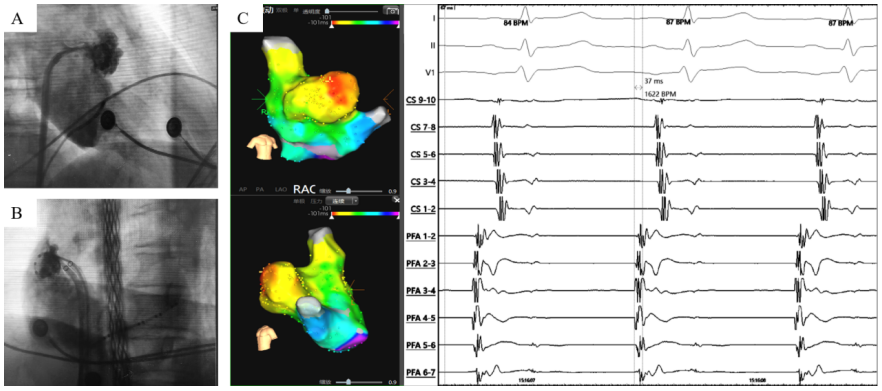

Figure 2. (A) PFA catheter positioned in the RAA and fluoroscopic right anterior oblique image of RAA angiography; (B) PFA catheter positioned in the RAA and fluoroscopic left anterior oblique image of RAA angiography; (C) Electroanatomic reconstruction of the RA/RAA and electrograms recorded by the PFA catheter located at the earliest activation site. PFA: pulse field ablation; RA: right atrium; RAA:right atrial appendage.

Figure 3. Subsequent AT termination to SR at the first application of PFA. AT:atrial tachycardia; SR: sinus rhythm; PFA: pulse field ablation.