Series Case Report of Efficacy and Safety of Radiofrequency Catheter Ablation to Treat Atrial Tachycardia Originating from the Distal Portion of the Atrial Appendage

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ABSTRACT:

Objective: Our case series report aims to investigate the efficacy and safety of radiofrequency catheter ablation (RFCA) to terminate atrial tachycardia (AT) originating from the distal portion of the atrial appendage.

Material and methods: Three-dimensional electroanatomic mapping (3-DEAM) systems (CARTO and Ensite Precision) were used in our study in two cases to create map and assess the anatomic location. Clinical features and electrocardiographic (ECG) characteristics were analyzed. We perform our ablations by using a infusing -cold saline and contact force sensing catheter at the appendages targeting loci of atrial tachycardia (AT) origin under the guidance of the 3-DEAM system. The curative effect and safe were evaluated.

Results: The ages of the two patients were 23 and 61 years old. With case 1, we found that the AT origin was from the right atrial appendage (RAA) and with case 2, we found that the AT origin was from the left atrial appendage (LAA). The ECG characteristics of AT from the RAA were as follows: (1) negative P waves in chest leads V1,V2; (2) positive P waves in peripheral leads II, III, aVF, D1, aVL. The ECG of the AT originated from LAA was characterized by: (1) positive P waves in chest leads V1,V2 and in inferior leads II, III, aVF but the P wave is obscured within the T wave. (2) P waves are isoelectric in leads DI; and (3) P waves are negative in lead aVL. Pre-operation echocardiography showed normal left ventricular ejection fraction (LVEF) and no thrombus in both cases. Radiofrequency ablation was successful in both patients. The earliest activation time of the successful RFA sites(the endpoint sites) was 34ms and 43ms before the onset of the P wave. There were no complications and long-term success was achieved in both patients during follow-up 23,5 months.

Conclusions: We prove that the atrial tachycardia which origin was from the atrial appendages showed the characteristic P-wave manifestations on ECG and RFCA to treat AT originating from the distal portion of the atrial appendage was safe and effective during follow-up average 23,5 months.

Keywords: *Case report, atrial tachycardia, atrial appendage, radiofrequency catheter ablation, distal of the atrial appendage.*

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***Received date**: 20/06/2025 **Revised date:** 26/06/2025*

***Accepted date:** 03/07/2025*

1. Introduction

Focal atrial tachycardias (ATs) originating from the distal portion of the atrial appendage are uncommon. The symptoms such as palpitation, chest distress and dyspnea. ATs can result in tachycardia-induced cardiomyopathy, among other complications (1). In the past, atrial appendage tachycardia (AAT) originating in the distal portion of the atrial appendage (AA) treated antiarrhythmic drugs or surgical excision to cure the arrhythmia (2). However, in recent years with the development of technology and innovations, the management of such cases has seen some advances (3,4).

In this report, two patients were diagnosed with AT originating from the AA using 3-dimensional (3D) electroanatomic mapping, and using contact force–sensing catheters to achieve success. Notably, both cases were successfully ablated immediately and no complications. Both cases demonstrate that current technology can minimize the complication rate in complex procedures and the risks of long-term antiarrhythmic drug or surgical therapy in the management of these complex arrhythmias.

2. Materials and methods

2.1. General information

In this study, two patients with AT who were admitted to the Hanoi Heart Hospital for radiofrequency catheter ablation (RFCA) to treat AT that originated from the AA. The ages were 23 and 61 years, the gender is male and female. Antiarrhythmic drugs is ineffective in terminating tachycardia. Atrial tachycardia was determined to originate from the RAA in case 1 and from the LAA in case 2 during the procedure.

Diagnostic criteria

Atrial tachycardia was diagnosed based on the following surface ECG criteria (5): (1) narrow QRS tachycardia and (2) P waves located pre-QRS waves or hidden in the QRS or T waves and were difference from sinus P wave morphology.

2.2. Protocol

2.2.1. Electrophysiological examination

Pre-operation, patients stopped using antiarrhythmic drugs for more than 5 half-lives. Firstly, we inserted coronary sinus catheter via the left subclavian vein with a 6F sheath. Then, we inserted the 6F and 8F vascular sheath via the right femoral vein. Subsequently two quadripolar catheters were inserted via the femoral veins and placed in the right ventricular apex, right atrial.

We recorded the bipolar intracardiac electrograms by using the Prucka CardioLab Electrophysiology system. We differentiated the AT and atrioventricular nodal reentrant tachycardia (AVNRT) by the following criteria: (6–8) (i) We paced in the right ventricle during the tachycardia to show ventriculoatrial dissociation; (ii) atrial activation sequence during the tachycardia was different from during ventricular stimulation; (iii) the A–A interval during the tachycardia was linking to V – V interval; and (iv) perpetuation of the tachycardia independent of atrioventricular (AV) block was observed.

We defined AT by the following criteria: (3) (i) atrial activation starts at a tiny area and from this site radiating in all directions in the atrial; (ii) intra-atrial activation duration is less than the tachycardia cycle length (TCL); (iii) Atrial tachycardia is terminated at the focal earliest activation site by ablating.

2.2.2. Mapping and radiofrequency ablation

In case 1, the right atrial (RA) was mapped with the PENTARAY® NAV ECO high-density

mapping catheter. In case 2, after transeptal puncturing, intravenous heparin was used to maintain the activated clotting time(ACT) at 300-350s and the left atrium (LA) was mapped with 10-pole mapping catheter. Electroanatomical mapping (activation mapping) during tachycardia was done to find out the earliest endocardial activation site relative to the surface P wave in the RA and LA. The CARTO (Biosense Webster) electroanatomical mapping system was used in case 1 and Ensite Precision was used in case 2 to facilitate mapping and assess the anatomic location. High-density mapping was done in the atrium, especially the RAA and LAA are areas with early activation.

In each case, the atrium was marked by multiple colors based on excitation times (color scale). The activation map shows red as the earliest area and purple as the last. The earliest excitation point was identified through accurate mapping of the red area. A cold saline infusion catheter with contact force sensing was selected, and 16 ml/min of cold saline was introduced to maintain a temperature of 43 C and a power of 20–35 W. If the ablation was effective, consolidate for 20 seconds (s) per point. AT was not observed 20 min after ablation. Atrial program stimulation after intravenous atropin and regular atrial program stimulation did not induce AT.

2.3. Follow-up

Post-operation, 12-lead ECG, 24-h ambulatory ECG, and echocardiography were done before discharge. Both cases were followed up for symptoms, 12-lead ECG at every 3 months for the first year and every year thereafter.

3. Results

In this study, both cases are rare because of originating from the AA, with a history of 1 year of AT failed to treat by antiarrhythmic drugs. Echocardiography showed normal function with LVEDDs of 45mm; 42mm, and LVEFs of 65%, 59%, respectively. Electrocardiogram characteristics were shown owing to changes in P wave morphology. In case 1 included the following: (1) P waves are negative in leads V1, V2; (2) P waves are positive in peripheral leads II, III, aVF, D1, aVL. In case 2 was as follows: (1) P waves are positive in leads V1, V2 and in inferior leads II, III, aVF but the P wave is obscured within the T wave. (2) P waves are isoelectric in leads I; and (3) P waves are negative in aVL.**Figure 1.**

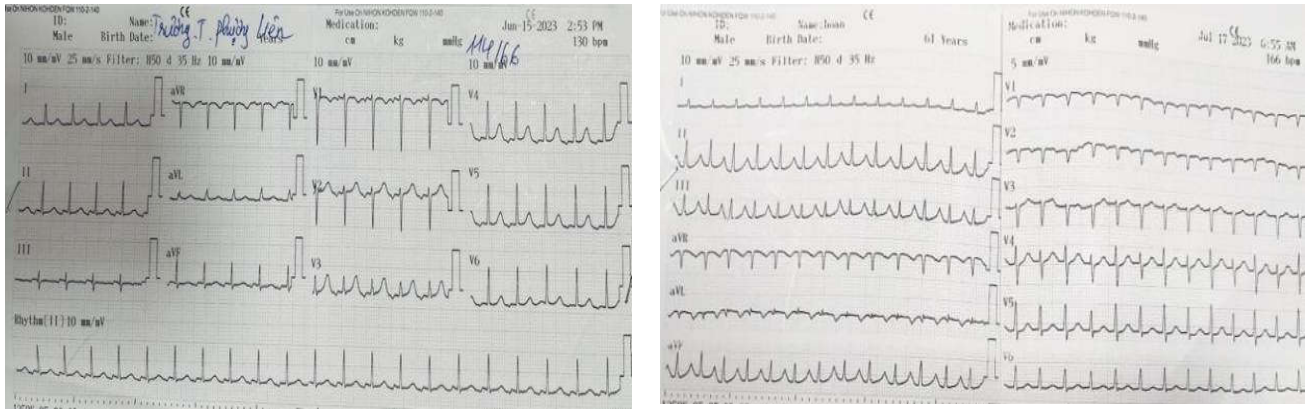

Figure 1. Tachycardia P-wave morphology

In case 1, the earliest excitation point was marked at the RAA during the procedure. The catheter was used with cold saline and contact force sensing, the ablation parameters (43 , 30W, 16ml/min) were selected with the pressure at 5–10g. First, we ablated near the base of the RAA but it was not effective. Then, we ablated at the distal of the RAA and atrial tachycardia was terminated after acceleration. Consolidate ablation was performed in 60s per three times. Atrial programmed stimulation failed to induce atrial tachycardia even with intravenous atropin. **Figure 2**

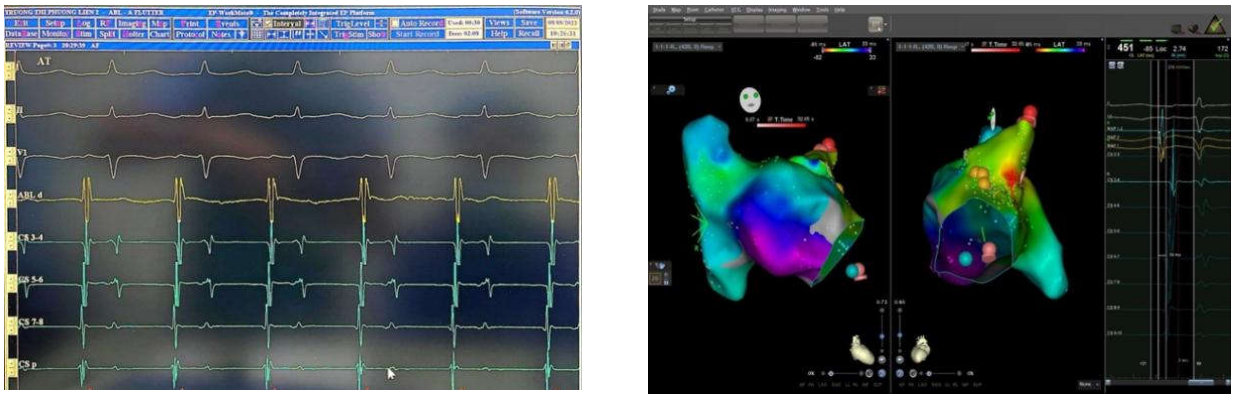

Figure 2. In case 1, the AT earliest excitation in CSp and marked at the distal of the RAA. The endocardial activation time of the successful RFA sites was 34ms before the onset of P wave

In case 2, the earliest excitation point was shown at the distal of the RAA. The catheter was perfused with cold saline and contact force sensing, the ablation parameters (43 , 30 W, 16 ml/min) were programed , with the contact force controlled at 5 g. Atrial tachycardia was terminated and consolidate ablation was performed in 60s per three times. Atrial programmed stimulation failed to induce atrial tachycardia, even with intravenous atropin. **Figure 3**. Post-operation, both cases shown sinus rhythm during 23,5 months follow-up.

A **B**

Figure 3. In case 2, the AT earliest excitation in CSd and marked at the distal of the LAA. The endocardial activation time of the successful RFA sites was 43ms before the onset of the P wave.

4. Discussion

The right atrial appendage tachycardia performs a typical ECG pattern with a high sensitivity (100%), specificity (98%), showing (1) P-waves are negative in leads V1, V2; (2) P waves are positive in leads II, III, aVF and aVL (9). Different from AT originated the left atrial appendage, not all RAAT seemed to present positive P-waves in leads II, III, and aVF due to the relationship in anatomic position of the right atrium which is lower to the left atrium (1,8,10). In our case report, the P waves in the ECGs of these cases were accordant to these manifestations.

The right atrium appendage structure is heterogeneous, the wall between the pectinate muscle is paper-thin on the lateral and inferior free wall; RFCA in this area can cause pericardial tamponade. Moreover, atrial tachycardia originating from this site may have multiple excitation loci and radiate in all directions. For this reason, AT originating from the RAA is hard to terminate and has a high rate of recurrence (11,12). The left atrial appendage anatomy, dense pectinate muscle jungle and complicated lobulations with narrow entrances can explain why an endocardial approach is difficult to ablate an atrial arrhythmia from the LAA.

With the two cases in our study, we used the three-dimensional mapping system to find the earliest excitation point. Ablations were performed by a cold saline-infused catheter and contact force sensing. A cold saline-infused catheter and contact force sensing were performed to minimize the risk of pericardial perforation and AA thrombosis. We successfully ablated the arrhythmia in both patients without complications.

Both patients have no tachycardia-induced cardiomyopathy because of new onset of tachycardia.

5. Conclusion

The atrial tachycardia originating from the atrial appendages showed characteristic P-wave manifestations on ECG and RFCA to treat AT originating from the distal portion of the atrial appendage was safe and effective.

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