Atrial Fibrillation Arising from the Left Atrial Appendage

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Abstract

A 63-year-old patient presented for curative treatment of drug-resistant paroxysmal atrial fibrillation (AF). After pulmonary vein antrum isolation was achieved, AF could be still induced and persisted, while rapid activation at the left atrial appendage was conducted to the left atrium in a decremental conduction manner. A step-wise incremental discrete radiofrequency energy application at the ostium of left atrial appendage completely eliminated the AF. Neither AF nor atrial tachyarrhythmias reappeared, even under isoproterenol infusion and vigorous rapid atrial stimulations. The patient has experienced no symptoms or exhibited ECG evidence of AF during a 6-month follow-up.

Key words: atrial fibrillation, catheter ablation, left atrial appendage

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Introduction

The development of atrial fibrillation (AF) requires a trigger and also an anatomical substrate capable of both initiating and perpetuating AF (1). It has been established that the initiation and maintenance of paroxysmal AF is frequently associated with ectopic beats inside the pulmonary veins (PV) (2). Previous studies have shown that together with the PVs, many extra-PV areas may be the source of the initiation and maintenance of AF (3, 4).

The left atrial appendage (LAA) has been underrecognized as a potential trigger (5). We herein present a patient with paroxysmal episodes of AF that were initiated and maintained by focal rapid discharges arising from the LAA and successfully eliminated by step-wise incremental discrete radiofrequency (RF) applications.

Case Report

A 63-year-old man with a 6-month history of palpitations and a 2-year history of hypertension was referred for curative treatment of drug-resistant paroxysmal AF. A twelve-lead ECG recorded before this admission demonstrated classic features of AF. According to the transthoracic echocardiogram (TTE) data, an enlarged left atrial (LA, 42 mm) was found. The other examinations on this admission, such as a chest radiogram, transesophageal echocardiography (TEE), coronary computed tomography, and laboratory tests, were all unremarkable.

Informed consent was obtained after an explanation concerning radiofrequency catheter ablation. Mapping of the left atrium and the PVs was performed by transseptal catheterization using an 8-Fr irrigated deflectable ablation catheter and a 7-Fr steerable circular catheter equipped with 10 electrodes. Pulmonary vein antrum isolation (PVAI) was performed under the guidance of the 3D left atrial geometry created by the NavX system. A RF current was delivered point-by-point for 30 s with a power of up to 35 W, target temperature <43°C, and an irrigation rate of 17 mL/min. A successful circumferential PVAI was indicated by the absence of any PV activity or by dissociated activity. All the PVs were successfully isolated (Supplementary material).

However, after PVAI, AF was still capable of being induced by atrial pacing with a cycle length 290 msec and persisted. Initially, the sites of reconnection around the PV antrum were checked, and when found, additional RF ablation was performed. In the re-constructed PV map, the conduction gap was identified at the carina between the left superior PV and the LAA. The point ablation at the gap eliminated all the PV potentials.

Next, the mapping sites of complex fractionated electrograms (CFEs) were identified in the left atrial surface areas. The sites with continuous CFEs indicated the most fraction-
Atrial fibrillation initiation with rapid activation at the level of the LAA (PV), which is conducted to the left atrium (CS) in a decremental conduction fashion. The circular catheter (PV) and the ablation catheter (ABL) are positioned at the body and the ostium of the LAA respectively. From top to bottom: surface ECG leads I, II, aVF, and V1; coronary sinus catheter (CS) from distal (1 to 2) to proximal (9 to 10); circular catheter (PV) from (1-2) to (9-10); and ablation catheter (ABL) from distal (d) to proximal (p). LAA: left atrial appendage.

Discussion

The embryological origin suggests that the LAA may initiate AF similar to the PVs (5). Previously, Takahashi et al. reported a single case of electric disconnection of the LAA for the elimination of foci maintaining AF (7). The LAA is a structure anatomically appended to the main body of the LA with a wide perimeter that interfaces with the atrial musculature. The anisotropic junctional tissue, with a complex fiber orientation, results in electrophysiological properties that may predispose this region to support anatomical reentry or to anchor functional rotors (8).

The areas surrounding the PVs, such as the LAA posterior ridge region, may be sources of the initiation and maintenance of AF. Important structures around this region that should be taken into consideration are the ligament of Marshall and Bachmann’s bundle. These findings suggest that LAA ridge ablation may eliminate primordial drivers or spatially confined substrates (8). A recent report demonstrated that the anterior portion of the left superior PV is one of the more difficult sites for maintaining good catheter contact during a left PV ablation (9). Therefore, the LAA ridge region may be an important target for catheter ablation in patients with AF (8), especially AF due to the LAA firing.
Similar to what was observed for the isolation of the PVs, the isolation of the LAA required segmental or circumferential lesions (5) at the ostium with the creation of split potentials or an electrogram voltage reduction of 50% after each application of RF energy (10). The latter is a more effective strategy to achieve freedom from AF, whereas the procedural success rate of focal ablation of the LAA is dismal.

Because the LAA has a very thin wall and may be prone to perforation, caution should be taken when LAA ostium ablation is performed. A step-wise incremental discrete RF energy application may reduce or even avoid perforation.

In the present case, circumferential LAA discharges were responsible not only for the initiation, but also for the maintenance of AF. The main findings of the present case demonstrate that (1) the LAA is a newly recognized site of AF initiation and maintenance and (2) a step-wise incremental discrete application of the RF energy could safely ablate the LAA ostium.

The authors state that they have no Conflict of Interest (COI).

References

1. Calkins H, Kuck KH, Cappato R, et al. 2012 HRS/EHRA/ECAS expert consensus statement on catheter and surgical ablation of atrial fibrillation: recommendations for patient selection, procedural techniques, patient management and follow-up, definitions, endpoints, and research trial design: a report of the Heart Rhythm Society (HRS) Task Force on Catheter and Surgical Ablation of Atrial Fibrillation. Developed in partnership with the European Heart Rhythm Association (EHRA), a registered branch of the European Society of Cardiology (ESC) and the European Cardiac Arrhythmia Society (ECAS); and in collaboration with the American College of Cardiology (ACC), American Heart Association (AHA), the Asia Pacific Heart Rhythm Society (APHRS), and the Society of Thoracic Surgeons (STS). Endorsed by the governing bodies of the American College of Cardiology Foundation, the American Heart Association, the European Cardiac Arrhythmia Society, the European Heart Rhythm Association, the Society of Thoracic Surgeons, the Asia Pacific Heart Rhythm Society, and the Heart Rhythm Society. Heart Rhythm 9: 632-696. e21, 2012.

2. Haissaguerre M, Jais P, Shah DC, et al. Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. N Engl J Med 339: 659-666, 1998.

3. Lin WS, Tai CT, Hsieh MH, et al. Catheter ablation of paroxysmal atrial fibrillation initiated by non-pulmonary vein ectopy. Circulation 107: 3176-3183, 2003.

4. Elayi CS, Fahmy TS, Wazni OM, Patel D, Saliba W, Natale A. Left superior vena cava isolation in patients undergoing pulmonary vein antrum isolation: impact on atrial fibrillation recurrence. Heart Rhythm 3: 1019-1023, 2006.

5. Di Biase L, Burkhardt JD, Mohanty P, et al. Left atrial appendage: an unrecognized trigger site of atrial fibrillation. Circulation 122: 109-118, 2010.
6. Haissaguerre M, Marcus F, Poquet F, Gencel L, Le Metayer P, Clementy J. Electrocardiographic characteristics and catheter ablation of parahisssian accessory pathways. Circulation 90: 1124-1128, 1994.

7. Takahashi Y, Sanders P, Rotter M, Haissaguerre M. Disconnection of the left atrial appendage for elimination of foci maintaining atrial fibrillation. J Cardiovasc Electrophysiol 16: 917-919, 2005.

8. Nakahara S, Hori Y, Hayashi A, et al. Impact of left atrial appendage ridge ablation on the complex fractionated electrograms in persistent atrial fibrillation. J Interv Card Electrophysiol 41: 55-64, 2014.

9. Kumar S, Morton JB, Lee J, et al. Prospective characterization of catheter-tissue contact force at different anatomic sites during atrial pulmonary vein isolation. Circ Arrhythm Electrophysiol 5: 1124-1129, 2012.

10. Lin YJ, Tai CT, Kao T, et al. Spatiotemporal organization of the left atrial substrate after circumferential pulmonary vein isolation of atrial fibrillation. Circ Arrhythm Electrophysiol 2: 233-241, 2009.

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