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CASE REPORT

Atrial Functional Substrate Mapping Predicts the Critical Isthmus of Left Atrial Localized Re-entrant Tachycardia; A Case Report

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Summary

A 79-year-old woman with persistent atrial fibrillation developed de-novo atrial tachycardia originating from the anterior left atrial wall. Functional substrate mapping (ILAM) during sinus rhythm identified slow conduction zones (deceleration zones) that matched the critical isthmus of the induced tachycardia. Targeted ablation at this site successfully terminated the arrhythmia. This case illustrates the utility of ILAM in identifying ablation targets in patients with atrial scarring.

Keywords: atrial fibrillation; atrial tachycardia; functional substrate mapping

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Introduction

Atrial tachycardia (AT) is a rhythm disorder that is encountered especially in patients with atrial structural remodeling. Although de-novo AT in the presence of structural heart disease is not a rare phenomenon, reentrant ATs are mostly seen after catheter ablation of atrial fibrillation (AF). Activation mapping using high-density catheters provides information about the localization, mechanism and critical isthmus of AT. However, degeneration of AT into AF or the inability to induce tachycardia in the laboratory are important limitations to create activation map of clinical ATs. Functional substrate mapping (FSM) is an emerging modality to characterize the atrial substrate, which can reveal conduction slowing beyond the low-voltage data. Since not all low voltage areas contain slow conduction regions, FSM may have a role to identify critical regions in patients with underlying scar, before induction of clinical AT. Hereby we aimed to present a case of de-novo AT in a patient with anterior wall low-voltage area, which was predicted using FSM prior induction of clinical AT.

Case Report

A 79-year-old female patient with a history of symptomatic persistent AF despite antiarrhythmic drugs was admitted to our department with the complaint of palpitations for the last 1 year. Physical examination findings and transthoracic echocardiography findings were insignificant except a left atrial diameter of 42 mm. The patient underwent a 3-dimensional electroanatomic mapping and catheter ablation procedure using CARTO (Biosense Webster) under general anesthesia. Left atrial voltage mapping using a high density pentaspline mapping catheter (Pentaray®; Biosense Webster) in sinus rhythm demonstrated low voltages-areas on the anterior wall using the voltage cut-off 0.1-0.5 mV (Figure 1A). An atrial FSM with isochronal late activation mapping (ILAM) was created during coronary sinus paced rhythm by annotating the offset of the latest atrial deflection from the baseline. The total atrial activation was set

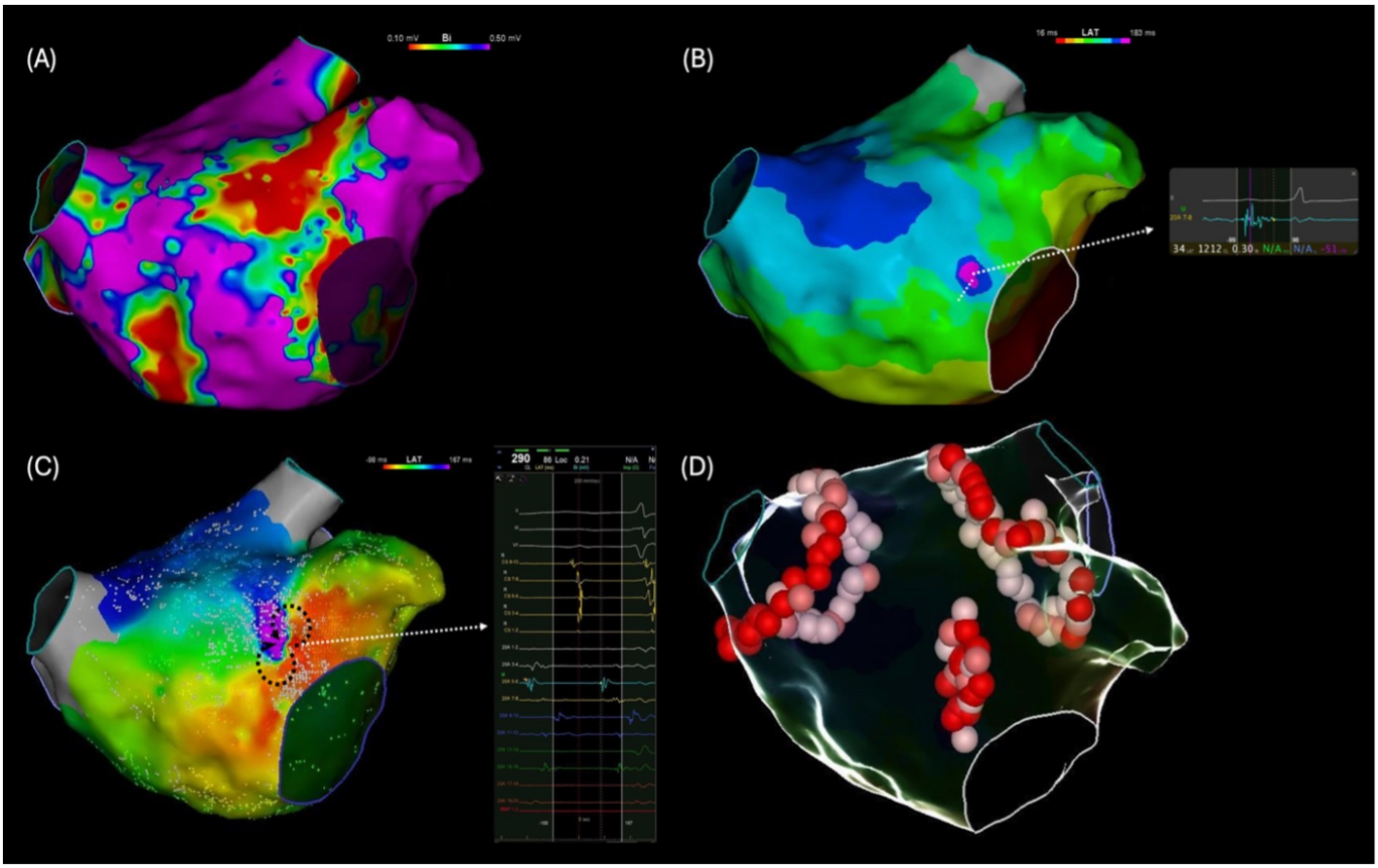

Figure 1. A) Left atrium voltage mapping demonstrated low-voltage area on the anterior wall. B) Isochronal late activation mapping revealed deceleration zone with continuous fragmented signals. C) The activation map demonstrated localized figure-of- eight reentry on the anterior wall, at the same site with deceleration zones during isochronal late activation mapping. D) Ablation lesions created locally on the anterior wall as well as around pulmonary veins.

between the onset of earliest and offset of latest local electrogram (EGM) with eight distributed isochrones of activation. The deceleration zone (DZ) was identified as an area with a radius of 1 cm where ≥3 isochronal color crowdings. Additionally, fragmented EGMs were tagged in the LA with different color. Fragmented EGM is defined as ≥4 deflections in atrial bipolar electrogram from the isoelectric line. Atrial ILAM during coronary sinus paced rhythm demonstrated ≥3 deceleration zones on the anterior wall with continuous fragmented signals in the latest activated zone (Figure 1B). Following functional and voltage mapping, a localized figure-of-eight reentry AT on the anterior wall was induced by programmed atrial stimulation with (Tachycardia cycle length: 290 msec) a reverse chevron coronary sinus activation pattern. (Figure 1C). Critical isthmus during activation mapping was colocalized with the DZ during ILAM. Using an irrigated tip radiofrequency catheter (ThermoCool SmartTouch, Biosense Webster), catheter ablation at this region terminated the AT. After performing localized ablation on the anterior wall, the procedure terminated with pulmonary vein isolation (Figure 1D). The patient discharged uneventfully and 6th month control revealed no arrhythmia recurrence.

Discussion

De-novo AT in patients with atrial scar is not an uncommon finding especially in patients presenting with AF. Targeting slow conduction areas and DZs identified during sinus/paced rhythm independent of voltage mapping, has been demonstrated as an effective strategy for substrate modification in ventricular tachycardia.[1] Recently, atrial FSM has

also been implemented to identify critical regions of reentrant ATs.[2,3] These studies demonstrated high correlation between slow conduction identified by FSM and the critical isthmus of AT. Therefore, slow-conducting regions shown by DZs can provide as a guide for ablation targets, particularly cases in which AT cannot be induced.

In this case, the critical isthmus of AT colocalized with the DZ identified by ILAM, in a patient who was admitted with persistent AF. Although pulmonary vein isolation is the standard method for catheter ablation, substrate abnormalities in terms of low-voltage regions and local electrocardiogram abnormalities are not infrequent in such patients. Therefore, identification of such abnormal substrate may guide the operator to target additional sites beyond pulmonary veins. In this case, identification of DZs during FSM in terms of ILAM enabled not only elucidation of slow conducting regions in the left atrium but also the creation of an ablation lesions on the anterior wall which exhibited widespread low-voltage zone as well as fractionated electrograms. As extensive substrate ablation strategies during catheter ablation of AF may contribute to iatrogenic AT recurrences, this method may refine the area of interest as an ablation target in such patients.[4]

In conclusion, atrial ILAM revealed functionally relevant slow-conducting site colocalized with critical isthmus of AT in a patient with persistent AF. Whether targeting FSM-identified substrates in AT/AF may contribute to lower recurrence rates necessitates further comparative studies.

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Informed consent

Written informed consent was obtained from the patient for the publication of the manuscript.

Conflict of Interests

None

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