

## Case Report

**Management of macro-reentrant right atrial tachycardia around multiple leads aided by high-density mapping**Matteo Bertini<sup>1,\*</sup>, Daniela Mele<sup>1</sup>, Francesco Vitali<sup>1</sup>, Cristina Balla<sup>1</sup>, Michele Malagù<sup>1</sup><sup>1</sup>Translational Medicine Department, Cardiological Center, University of Ferrara, 44124 Ferrara, Italy\*Correspondence: [matteo.bertini@unife.it](mailto:matteo.bertini@unife.it) (Matteo Bertini)

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**Abstract**

**Background:** A 61-year-old male with Steinert Dystrophy and prior history of cardiac implantable device complained of highly symptomatic right atrial tachycardia. Unresponsive to pharmacological therapy. **Methods:** The patient underwent catheter ablation procedure aided by high-density mapping. **Results:** Ablation procedure was successful. **Conclusions:** This unique case report highlights the role of high-density mapping in the identification of critical isthmus and management of macro-reentrant tachycardia in complex situations such as the presence of multiple leads in the chamber.

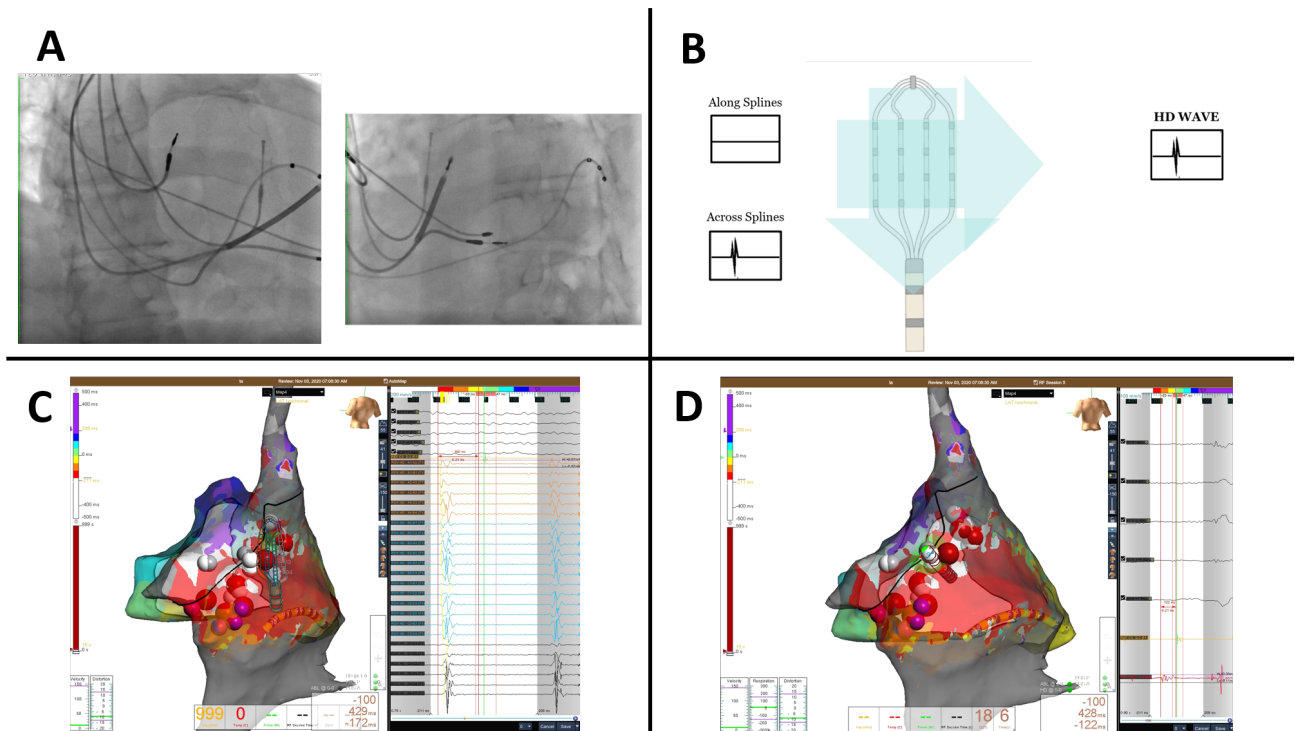
**Keywords:** Right atrial tachycardia; High density mapping; Critical isthmus**1. Case report**

A 61-year-old male with Steinert Dystrophy had previously undergone biventricular defibrillator implantation for complete atrioventricular block. The patient has one pacing lead in the right atrium (RA), three pacing leads in the right ventricle, and one pacing lead in a lateral coronary vein, (Fig. 1A), all lead either ends or passes through the RA. All leads have been implanted for several years, the last lead being implanted 7 years earlier. In 2017, the patient presented with symptoms of exertional dyspnea and asthenia. The patient was diagnosed with atrial tachycardia after device interrogation and review of standard electrocardiogram. The atrial tachycardia was subsequently terminated by high-rate atrial pacing from the device. The patient was put on amiodarone and was free from atrial tachycardia and related symptoms for 18 months. Symptomatic atrial tachycardia recurred after 18 months. We scheduled the patient for atrial tachycardia ablation when high-rate atrial pacing was no longer effective in terminating the tachycardia.

The procedure was performed through the right femoral vein. Near zero fluoroscopy procedure was performed (totally zero fluoroscopy was not possible due to several pacing leads in the heart chambers) with 3D-electro-anatomical mapping of the RA using Ensite-Precision system (Abbott, St. Paul, MN, USA). Atrial tachycardia was incessant with a cycle length of 430 msec. A decapolar electrode catheter was advanced into the RA showing an extremely low voltage chamber (Cut-off values for voltage mapping were set at 0.1–0.5 mV, inferior limit were also set at 0.05 mV to confirm scar areas) [1]. Based on signals from the decapolar catheter, a large scar in the RA was seen. The decapolar catheter was positioned at the lateral wall and used as reference for mapping atrial tachycardia. Atrial tachycardia was mapped through a grid-style high-

density mapping catheter (HD Grid Mapping-Catheter, Abbott, St. Paul, MN, USA). HD Grid has a unique electrode pattern that enables simultaneous measurement of voltage in two directions and automatically selects the highest amplitude electrogram from two orthogonal bipoles, reducing directional sensitivity and allowing an accurate mapping of the low voltage areas (Fig. 1B). After the voltage map was performed with HD Grid, the true scar was identified around coronary sinus, close to inferior and superior vena cava. The anatomical shell of the RA and activation map of the tachycardia was accurately and quickly performed with the HD Grid. More than 10000 points were collected during mapping of the right atrial macro-reentrant tachycardia (Fig. 1C). Based on the electro-anatomical map, critical isthmus of the tachycardia was identified between superior vena cava and crista terminalis (white color in Fig. 1C,D and Video 1). This was also confirmed by entrainment maneuver. An irrigated ablation catheter (irrigation flow was set to 2 mL/minute during mapping and 15 mL/minute during radiofrequency) with a flexible tip (Flexability<sup>TM</sup> Ablation-Catheter, Abbott, St. Paul, MN, USA) [2] was then introduced and placed in the critical isthmus (Fig. 1D). Tachycardia was terminated after two radiofrequency application at 35 watts, while complete block of the critical isthmus was observed after 14 radiofrequency applications with a total duration of 273 seconds. Bidirectional block was then confirmed with pacing from high RA close to superior vena cava, low RA close to inferior vena cava, lateral wall of RA and ostium of coronary sinus and activation mapping. During final electrophysiological testing with and without an isoprenaline infusion, the tachycardia was uninducible not only with triple extra-stimuli but also with high-rate pacing. No recurrence of atrial tachycardia was observed at the 6-month follow-up.





**Fig. 1. Central figure.** (A) Fluoroscopic images in right anterior oblique view (left image) and left anterior oblique view (right image) showing 6 pacing lead passing in the right atrium. (B) HD Grid catheter in the middle. Thick light blue arrows indicate the direction of wavefront. HD Wave automatically selects the highest amplitude electrogram from two orthogonal bipoles, reducing directional sensitivity. (C) HD Grid catheter in critical isthmus of the tachycardia showing earlier signals than the reference. (D) Ablation catheter in critical isthmus of the tachycardia showing earlier signals than the reference. Of note, the amplitudes of these signals are lower than the amplitude recorded with HD Grid catheter.



**Video 1. Atrial tachycardia propagation in the right atrium.** The embedded movie may also be viewed at <https://www.imrpress.com/journal/RCM/23/1/10.31083/j.rcm2301001>.

This very unique case highlights some important points: (1) multiple leads in a cardiac chamber may have contributed to the formation of an electrical circuit which can become incessant and difficult to control with drugs [3]. (2) HD Grid is a useful tool for mapping very low voltage chambers. The unique grid-patterns design enables bipole recording along and across the splines. Reduced electrode spacing (3-3-3) and microelectrodes (1 mm) allow us to acquire clear near-field signals, without interference from far-field. With the use of the HD Wave configuration and the Best Duplicate algorithm, variability in bipolar electrogram characteristics associated with different orientations of the electrodes relative to the wavefront can be significantly reduced. By keeping voltage point with the highest amplitude from orthogonal bipoles, the HD Grid overcomes the limit of bipolar blindness, and allows us to eliminate the areas of false low voltage. Compared to standard decapolar catheter, it enables us to define the real low voltage areas better. (3) HD Grid activation mapping allows accurate identification of critical isthmus of macro-reentrant tachycardia through quick acquisition of thousands of points. (4) extreme maneuverability of HD Grid is very important especially in difficult conditions such as crowded right atrium with multiple pacing leads. Finally, the grid shape of the catheter avoided possible catheter entrapment during the procedure by pacing leads or valvular structure (Fig. 1).

## 2. Conclusions

This case report highlights the added value of high density mapping with HD Grid for the treatment of macroreentrant tachycardia originating in chamber that is difficult for navigation and mapping due to the presence of multiple pacing leads.

## Author contributions

MB, DM, FV, CB, MM—contributed to the study design; MB, DM, FV, CB, MM—data analysis; MB, DM, FV, CB, MM—drafting of the manuscript.

## Ethics approval and consent to participate

Patient gave informed consent for inclusion before he participated in the study.

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## Conflict of interest

The authors declare no conflict of interest. Matteo Bertini is serving as one of the Guest editors of this journal. We declare that Matteo Bertini had no involvement in the peer review of this article and has no access to information regarding its peer review. Full responsibility for the editorial process for this article was delegated to Peter A. McCullough.

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