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IMAGING VIGNETTE

ADVANCED

ECG CHALLENGE

A Tale of 2 Hearts

Simultaneous Dual Tachycardias Occurring 22 Years After Orthotopic Heart Transplantation

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ABSTRACT

At 22 years following heart transplantation, a patient presented with incessant atrial flutter. During electrophysiologic study, 2 simultaneous atrial arrhythmias were mapped, 1 from the donor and 1 from the recipient's heart. High-density mapping allowed for rapid identification of electrically abnormal areas, which were successfully ablated, thus restoring sinus rhythm. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2019;1:235–7) © 2019 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Atrial arrhythmias presenting after orthotopic heart transplantation (OHT) may be related to organ rejection or reentrant circuits around surgical anastomosis.

A 73-year-old man who underwent orthotopic heart transplantation in 1996 (biatrial technique) for ischemic heart disease was referred for evaluation of recurrent symptomatic palpitations, shortness of breath, and atrial flutter (AFL) with rapid ventricular response on a 12-lead electrocardiogram. Attempts at rhythm control with antiarrhythmic medications and cardioversion had failed. Endomyocardial biopsy results were negative for rejection, a coronary angiogram showed nonobstructive transplant coronary disease, and an echocardiogram documented preserved biventricular function. An electrophysiological study was performed. An octapolar catheter was placed in the coronary sinus, and a multielectrode catheter (Advisor HD Grid, Abbott Cardiovascular) was used to map the right atrium (RA). Three-dimensional mapping (EnSite Precision, Abbott Cardiovascular) was used to obtain voltage and activation maps. The following observations were made:

1. Baseline electrocardiogram showed AFL with incomplete right bundle branch block (Supplemental Figure 1).
2. A distinct right atriotomy scar (bipolar voltage <0.1 mV) separated the donor RA and the native RA (**Figure 1A**).
3. A macro-re-entrant AFL with 2:1 atrioventricular conduction, a tachycardia cycle length (TCL) of 360 ms, and an area of slow conduction in the cavotricuspid isthmus of the donor RA, anterior to the atrial anastomosis, were noted (**Figure 1B**, Video 1).
4. The presence of an atrial tachycardia (AT) in the posterior (native) RA with a TCL of 240 ms and exit block into the donor RA. The AT had continuous fractionated electrograms spanning the entire TCL of the arrhythmia within an area of 0.3 cm^2, consistent with a micro-re-entry (**Figure 1C**, Video 1).
5. No left atrial arrhythmias were observed.

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ABBREVIATIONS AND ACRONYMS

AFL = atrial flutter

AT = atrial tachycardia

CTI = cavo-tricuspid isthmus

ECG = electrocardiogram

EP = electrophysiologic

OHT = orthotopic heart transplantation

RA = right atrium

RF = radio-frequency

TCL = tachycardia cycle length

RF ablation at the mid-cavotricuspid isthmus using an irrigated ablation catheter (Flexibility, Abbott Cardiovascular) within a narrow channel of conduction (Figure 1B) terminated the AFL with a prolonged sinus pause requiring temporary pacing, followed by sinus rhythm resumption. The AT continued in the native RA uninterrupted. Focal radiofrequency ablation in areas of continuous fractionated electrograms in the posterior right atrial wall slowed down the AT until it eventually terminated (Figures 1C and 1D). Post-ablation, no arrhythmias were inducible despite pacing maneuvers on and off isoproterenol infusion. At 12 months of follow-up, the patient remains arrhythmia free.

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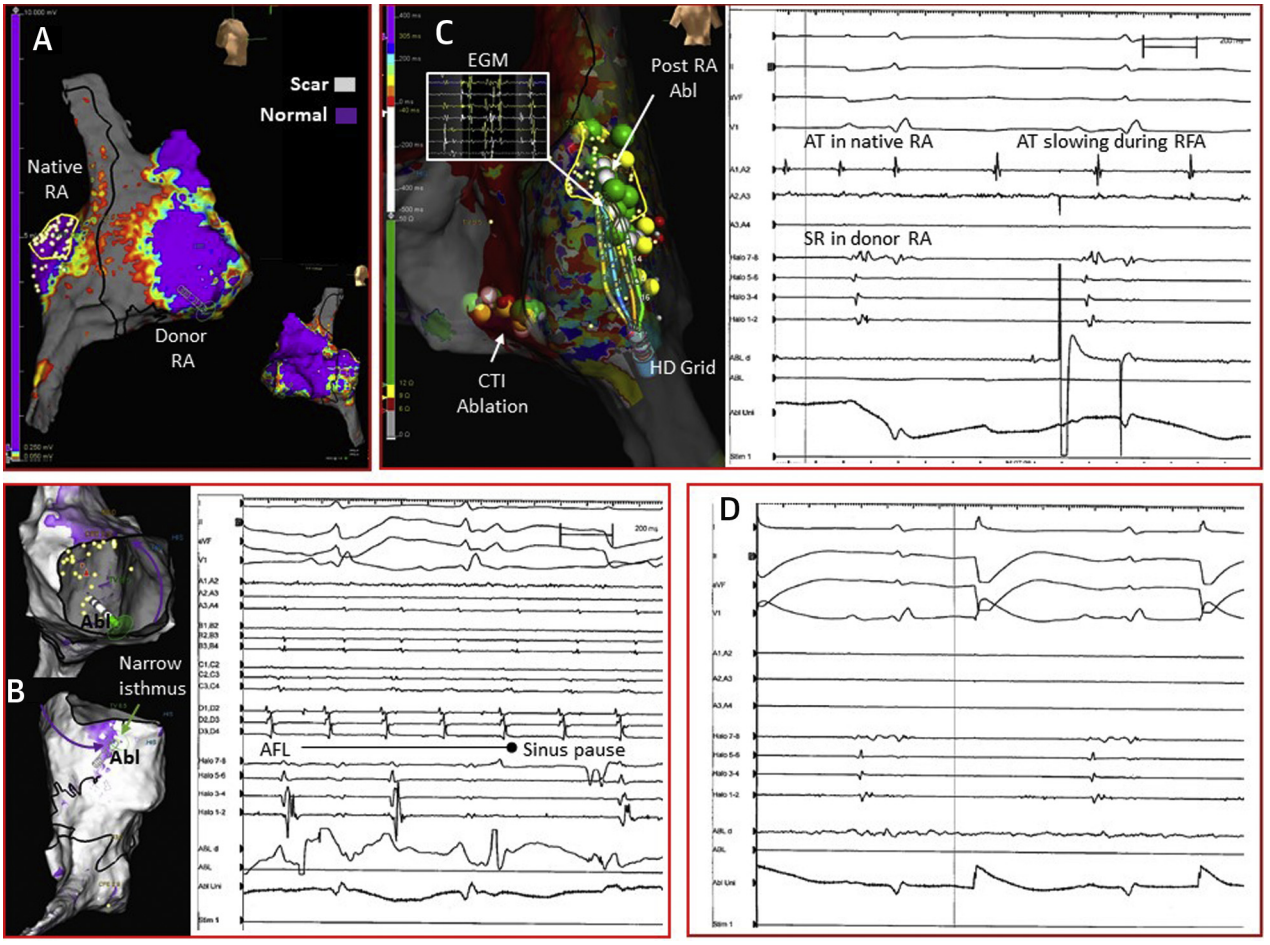
This case illustrates the arrhythmogenic substrate encountered in patients who have undergone orthotopic heart transplantation where fibrosis and atriotomy scars favor both macro-re-entrant and micro-re-entrant rhythms, particularly in patients who underwent a biatrial anastomosis surgical technique, where the right atrial architecture is compromised (1). In this case, the right atriotomy scar

FIGURE 1 A 3-Dimensional Map and Intracardiac Electrograms



(A) Bipolar voltage map (right anterior oblique) showing a right atrial atriotomy scar **(gray areas)** and 2 distinct atrial regions: the donor right atrium (RA) anteriorly and the native right atrium posteriorly. **(B)** Right atrial propagation maps (anteroposterior and inferior) showing atrial flutter counterclockwise activation **(purple arrows)** and intracardiac electrograms (EGMs) during cavotricuspid isthmus ablation (Abl). A single ablation **(green arrow)** terminated the atrial flutter (seen at Halo 1-2 to 7-8 channels) with a sinus pause followed by a premature atrial beat. **(C)** Right atrial activation map (posteroanterior) showing a multielectrode catheter in the posterior right atrium with corresponding intracardiac electrograms. Note the highly fractionated electrograms **(inset)** corresponding to area of micro-re-entrant atrial tachycardia (AT). Radiofrequency ablation (RFA) in this area **(green dots)** slowed down the atrial tachycardia (channel A1-A2). Note sinus rhythm (SR) on the electrocardiogram while the atrial tachycardia is still ongoing, proving the atrial tachycardia was confined to the native right atrium. **(D)** Final electrocardiogram and intracardiac electrograms post-ablation showing sinus rhythm and no visible electrograms (channels A1 to A4) in the native right atrium. See Video 1. CTI = cavotricuspid isthmus.

defined 2 separate and independent atrial myocardial arrhythmia substrates: 1 macro-re-entrant AFL in the donor heart and 1 micro-re-entrant AT from the native heart. The observation that termination of the AFL with sinus rhythm restoration did not affect the TCL of the AT proves that these 2 arrhythmias were independent and occurred in electrically isolated areas of the RA (2) and that only the AFL was evident on the electrocardiogram because the AT was contained in the native RA. Finally, because medical therapy often fails in patients with these arrhythmias, high-density mapping techniques are rapid and accurate tools to facilitate the understanding of these complex arrhythmia circuits and to guide a successful ablation strategy (3).

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KEY WORDS atrial anastomosis, atrial arrhythmias, high-density mapping, orthotopic heart transplantation, radiofrequency ablation

APPENDIX For a supplemental figure and a video, please see the online version of this paper.