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SPOTLIGHT

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Focal post-Maze atrial tachycardia mimicking macroreentrant tachycardia around the Maze lesion diagnosed using ultra-high-resolution mapping

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An 83-year-old female with a history of surgical secundum-type atrial septal defect (ASD) closure, tricuspid annuloplasty, and Maze surgery was referred to our hospital for catheter ablation of atrial tachycardia (AT). Prior Maze surgery was performed via vertical left atriotomy with radiofrequency (RF) energy. The Maze lesion sets are demonstrated in Figure 1; left atrial lesion sets included left atrial posterior wall isolation, left atrial appendage resection, and a mitral annulus (MA) line. ASD closure was performed by direct suture. Her clinical AT (AT1, cycle length of 285 ms) had a clockwise perimitral pattern because of a gap at the annular side of the MA line (annular MA line gap). AT1 was terminated by left atrial anterior linear ablation (Figure S1). Subsequently, activation maps of the right and left atrium were acquired during sinus rhythm to determine whether a residual gap existed. The left atrial anterior line and posterior wall isolation were durable on the activation map. The map also exhibited double potential with the interval of 135 ms (Figure 2) at the posterior side of the MA line, which indicated a local conduction block. The annular side was conductible as well as during AT1.

We checked the AT inducibility after closing the right atrial posterior linear lesion gap. Burst pacing from the coronary sinus catheter induced AT2 with a fluctuating cycle length of 220–240 ms. AT2 seemed to rotate around the MA line (Figure 3, middle panel and

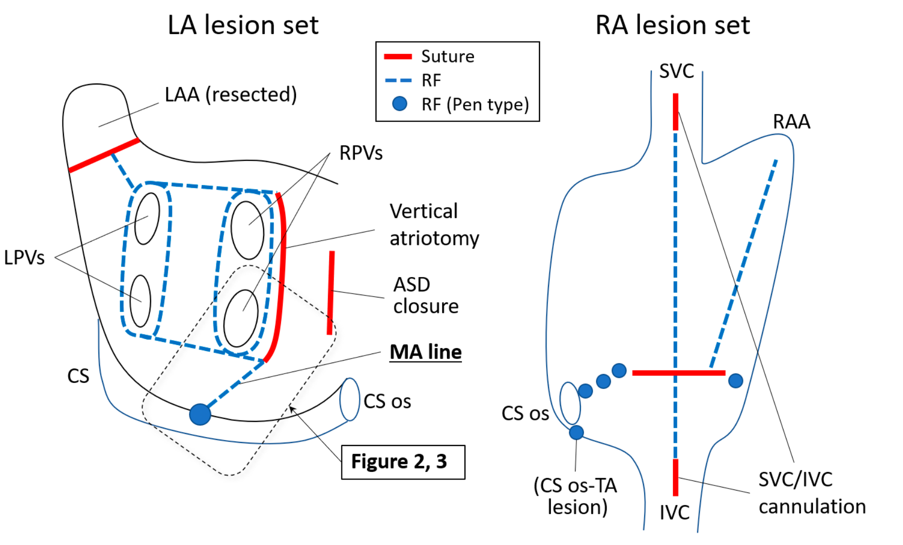

FIGURE 1 Lesion sets of the prior Maze procedure. Red lines indicate cut and suture lesions, and dotted blue lines and points indicate radiofrequency lesions. ASD, atrial septal defect; CS, coronary sinus; IVC, inferior vena cava; LAA, left atrial appendage; LPV, left pulmonary vein; MA line, mitral annulus line; RAA, right atrial appendage; RF, radiofrequency; RPV, right pulmonary vein; SVC, superior vena cava; TA, tricuspid annulus.

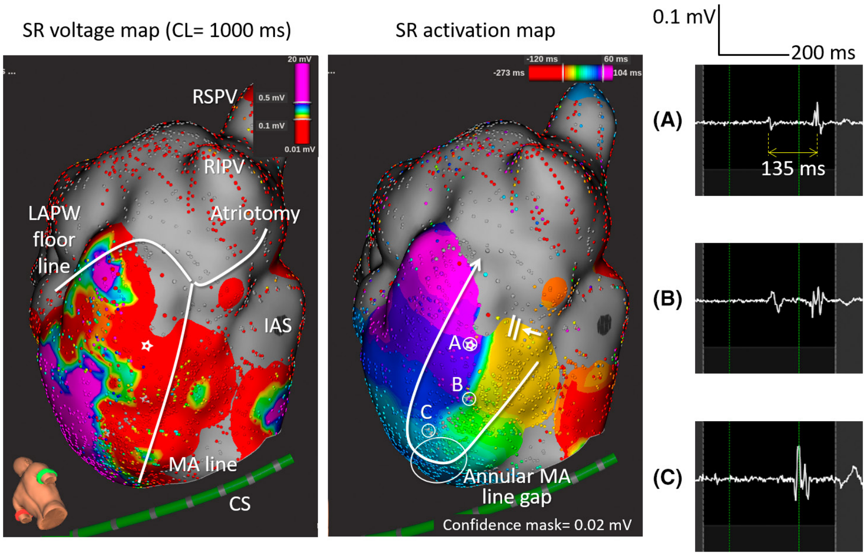

FIGURE 2 Left atrial voltage map and activation map during sinus rhythm (right posterior oblique-caudal view). Right panels (A–C) indicate local electrocardiograms along the MA line at each point on the activation map. The scar threshold (confidence mask) is set at 0.02 mV for each map. CL, cycle length; IAS, interatrial septum; LAPW, left atrial posterior wall; RSPV, right superior pulmonary vein; RIPV, right inferior pulmonary vein. Other abbreviations as in Figure 1.

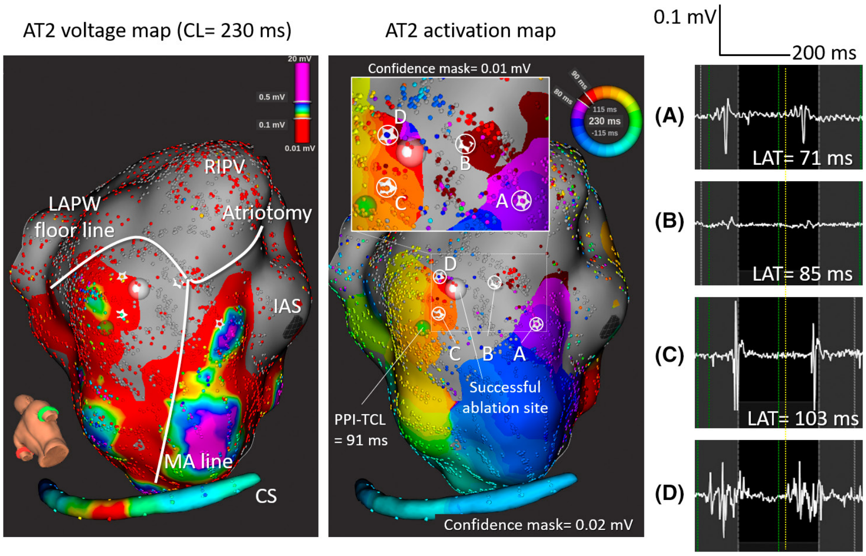

FIGURE 3 Left atrial voltage map and activation map during AT2 (the same angle as Figure 2). Beat acceptance criteria for cycle length was set at 230 ± 10 ms. Right panels (A–D) indicate local electrocardiograms at each point on the activation map. The scar threshold (confidence mask) is set at 0.02 mV for each map and 0.01 mV for the magnified view in the middle panel. A brown-colored area appears near point B by lowering the confidence mask, indicating a later activation than the purple-colored area near point D. The onset of the fractionated local electrocardiograms at point D (dotted yellow vertical line) also preceded that of points A and B. PPI, post-pacing interval; TCL, tachycardia cycle length. Other abbreviations as in Figures 1 and 2.

Video S1) even though the posterior side of the MA line had presented a local conduction block during sinus rhythm, as described above.

The activation map with an extremely low scar threshold (0.01 mV) revealed that the head-meets-tail pattern at the posterior side of the MA line was a false one, and fractionated electrocardiograms with long duration were found near the apparent AT2 breakout site (Figure 3, middle and right panels). An entrainment pacing maneuver near the MA line revealed a long post-pacing interval (Figure S2). According to these findings, we diagnosed AT2 as a focal AT originating behind the MA line. An RF application at the apparent breakout site immediately terminated AT2 within 2 s (Figure 4), and AT2 became non-inducible after the ablation. The patient has been free from any atrial tachyarrhythmia for 8 months after the ablation.

This case illustrated the usefulness of an ultra-high-resolution mapping system in the ablation of both macroreentrant and focal post-Maze ATs. AT1 was a macroreentrant clockwise perimitral AT. The ultra-high-resolution voltage map of AT1 presented a broad low voltage area at the anterior wall (Figure S1, upper left panel). This finding led us to create a left atrial anterior linear ablation in place of closing the MA line gap to prevent localized reentry within the left atrial anterior wall.

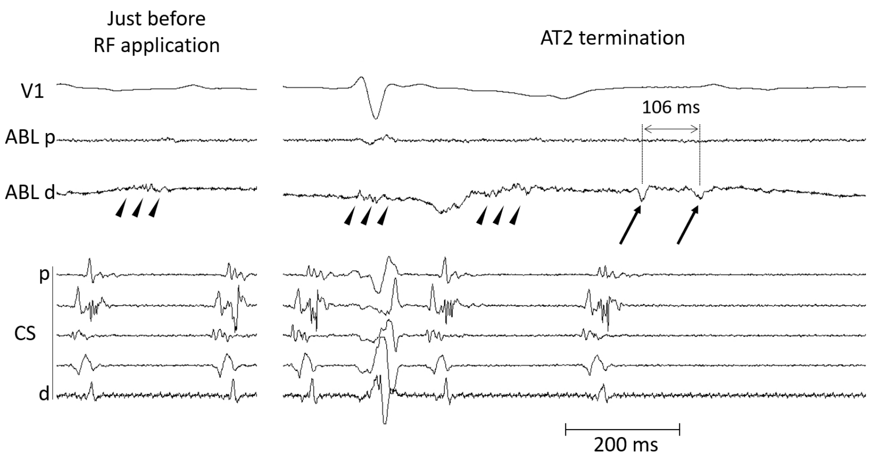

FIGURE 4 Local electrocardiograms at AT2 termination site. Notably, a fractionated potential (arrowheads) changed to a double potential (arrows) at the timing of AT2 termination. ABL, ablation catheter; CS, coronary sinus; d, distal; p, proximal; RF, radiofrequency.

An activation map of AT2 was consistent with the macroreentrant tachycardia around the MA line. However, a local conduction block of the posterior side of the MA line had been confirmed before AT2 induction. The extremely low scar threshold activation map uncovered the "false" head-meets-tail pattern, and the focal AT originating behind the MA line was suspected. Fractionated local electrocardiograms with long duration and the long post-pacing interval after entrainment pacing at the apparent AT2 exit site favored a microreentrant mechanism.[1] At the AT2 termination timing, the fractionated potential changed to a shorter interval double potential than that observed during sinus rhythm nearby (106 ms vs. 135 ms: Figures 2 and 4). This finding also favored the microreentrant theory; the former double potential was suspected to reflect the conduction block of the microreentrant circuit confined behind the MA line and the later the transverse conduction block over the MA line. The "pseudo-macroreentrant" activation pattern occurred because the AT2 cycle length was almost equal to the conduction time around the MA line.

While RF devices facilitate Maze surgery,[2] the arrhythmogenic substrates related to the RF Maze lesion have yet to be elucidated. Both focal and macroreentrant ATs were reported to occur after Maze surgery.[3,4] Therefore, checking the AT inducibility is very important even after all macroreentrant circuits were eliminated, as in the present case. An ultra-high-resolution mapping system concomitant with the evaluation of local electrocardiograms and entrainment pacing maneuvers facilitates the ablation of complex ATs after Maze surgery.

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CONFLICT OF INTEREST

Hiroshi Tada is a member of Journal of Arrhythmia editorial board.

DATA AVAILABILITY STATEMENT

Available upon reasonable request.

ETHICS APPROVAL

N/A.

PATIENT CONSENT STATEMENT

N/A (patient's clinical information was utilized based on the IRB approval #20180040).

CLINICAL TRIAL REGISTRATION

N/A.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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