ESC European Society of Cardiology

European Heart Journal - Case Reports (2024) **8**, ytae389
https://doi.org/10.1093/ehjcr/ytae389

Successful high-density electroanatomical mapping and ablation using ultrasound hydrogel pad for epicardial ventricular tachycardia under direct vision through thoracotomy approach

Yuka Seki [1]*, Yukio Sekiguchi[1], and Tomohiro Iwakura [2]

[1]Department of Cardiovascular Internal Medicine, Sakakibara Heart Institute, 3-16-1 Asahi-cho, Fuchu-shi, Tokyo 183-0003, Japan; and [2]Department of Cardiovascular Surgery, Sakakibara Heart Institute, Tokyo, Japan

Received 17 March 2024; revised 18 June 2024; accepted 29 July 2024; online publish-ahead-of-print 1 August 2024

ESC curriculum 5.6 Ventricular arrhythmia • 7.5 Cardiac surgery

Case presentation

A 78-year-old male patient, who underwent open-chest surgery for double valve replacement with epicardial placement of the left ventricular (LV) lead and subsequent secondary thoracotomy for haemostasis 3 years ago, was admitted to our hospital due to repetitive appropriate cardiac resynchronization therapy with defibrillator (CRT-D) shock therapy for ventricular tachycardia (VT) (*Figure 1A*). His baseline electrocardiogram showed atrial fibrillation with biventricular pacing (*Figure 1B*). As no local late potentials (LPs) were found in the LV endocardial map with limited low-voltage area during the first session of VT ablation 3 months prior (*Figure 1C* and *D*), an epicardial procedure was planned. Given the presence of epicardial LV lead and the anticipated severe epicardial adhesion resulting from the history of two open-chest surgeries, a percutaneous approach or blind catheter manipulation under pericardial fenestration was deemed to be high risk. As an alternative, a left thoracotomy approach was recommended. To obtain stable and precise impedance-based electroanatomical data using EnSite NavX™ Mapping System under the open-chest surgery conditions, hydrogel pad for ultrasonography (HydroAid®, KIKGEL) was attached on the exposed myocardium. Both the mapping catheter (Advisor™ HD Grid) and irrigated-tip catheters (TactiFlex SE™), positioned between the gel pad and the myocardium, could easily acquire a precise electroanatomical map (EAM) with high density and safely perform successful ablation under direct vision (*Figure 1E*, Supplementary material online, *Video S1*). Comparable mapping and ablation performance under this condition had already been confirmed in the pig's epicardium in advance (*Figure 1F* and *G*). The LV inferior to the posterior sites revealed a low-voltage area, in which the deceleration zone (DZ) was found on the isochronal late activation map under a biventricular pacing rhythm. Successful LP abolition ablation was performed, leading to the non-inducibility of any VTs by programmed electrical stimulation using single, double, or triple extrastimuli from the right ventricle (*Figure 1H–J*).

When performing epicardial mapping through surgical approach under direct vision, air contamination must be avoided by mainly filling with electrolyte solution, as current 3D mapping system requires stable electromagnetic condition to acquire precise spatial information and local electrogram.[1–4] In this case, closely attaching the ultrasonic hydrogel pad, which includes over 90% water, to the epicardium successfully

* Corresponding author. Tel: +81 80 9285 9472, Email: yuseki@shi.heart.or.jp
Handling Editor: Patrick Badertscher
Peer-reviewers: Linh Ngo; Teodor Serban

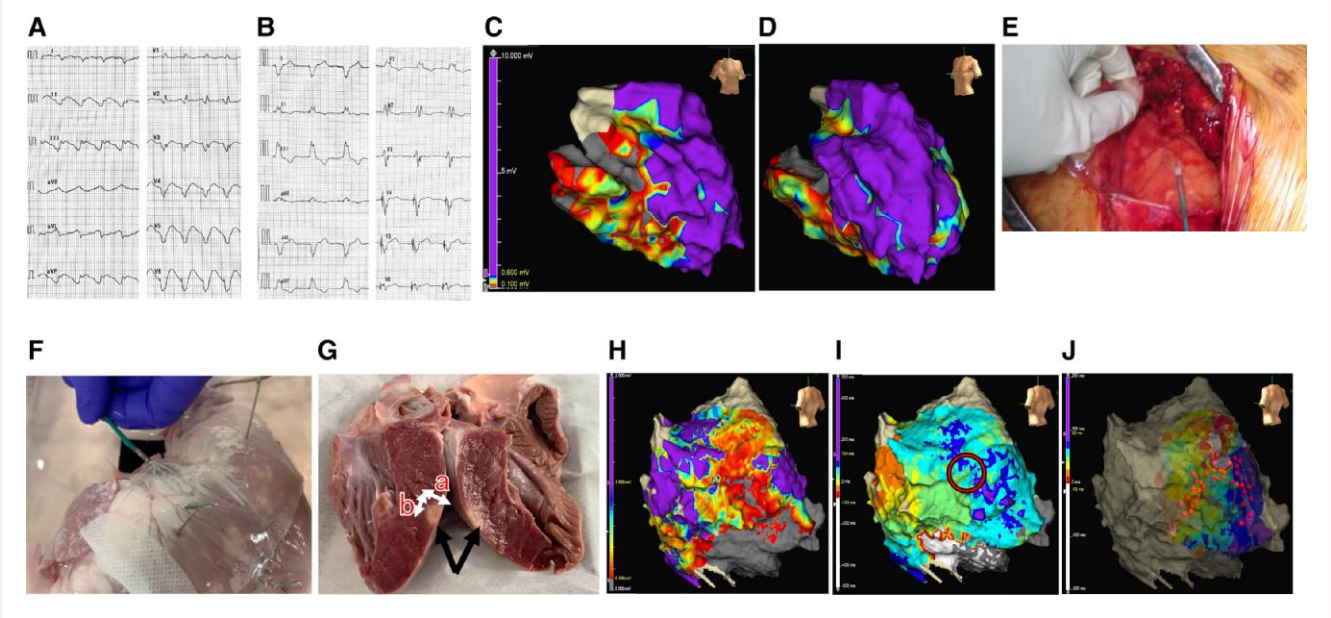

Figure 1 (*A*) Twelve-lead electrocardiogram showing clinical ventricular tachycardia at 150 b.p.m. (*B*) Baseline electrocardiogram showing atrial fibrillation with biventricular pacing. (*C* and *D*) Left ventricular endocardial bipolar voltage map acquired in the first session of ventricular tachycardia ablation. Right anterior oblique view (*C*) and left anterior oblique view (*D*), respectively. (*E*) Epicardial electrical mapping is performed by manipulating grid catheter under direct vision. (*F*) Examination of mapping and ablation of the epicardium using hydrogel pad. Grid catheter is inserted into the space between hydrogel pad and pig's epicardium. Mapping points are acquired on the virtual surface in the 3D mapping system, and (*G*) radiofrequency applications are experimentally performed with power of 45 or 50 W, flow rate of 20 mL/min, and duration of 60 s. Two of each lesion (black arrows) size with the depth (a) of 6.0 and 7.2 mm, and the width (b) of 11.1 and 11.3 mm, respectively, confirm comparable effectiveness of radiofrequency ablation under this condition. (*H*) Left ventricular epicardium bipolar voltage map. (*I*) Isochronal late activation map showing one deceleration zone (circled area). (*J*) Isochronal late activation map of post-ablation. Radiofrequency ablation is performed linearly through the deceleration zone to the lateral border zone in addition to late potential abolition (red tags), confirming disappearance of the deceleration zone and late potentials after the procedure. Total procedural, fluoroscopy, and ablation times were 475 min, 198 s, and 3926 s, respectively.

prevented air infiltration into pericardial space to achieve the precise epicardial EAM and successful VT ablation under stable impedance surroundings through open-chest access.

Supplementary material

Supplementary material is available at *European Heart Journal – Case Reports* online.

Acknowledgements

The authors would like to thank all the members of the Sakakibara Heart Institute for their surgical procedures and full support for the ablation.

Consent: Consent for publication was obtained from the patient, in line with the COPE best practice guidelines.

Conflict of interest: None declared.

Funding: None declared.

Data availability

The authors confirm that the data supporting the findings of this study are available within the article and its supplementary materials.

References

1. Maury P, Monteil B, Marty L, Duparc A, Mondoly P, Rollin A. Three-dimensional mapping in the electrophysiological laboratory. *Arch Cardiovasc Dis* 2018;**111**:456–464.
2. Zhang PP, Heeger CH, Mathew S, Fink T, Reissmann B, Lemeš C, et al. Left-lateral thoracotomy for catheter ablation of scar-related ventricular tachycardia in patients with inaccessible pericardial access. *Clin Res Cardiol* 2021;**110**:801–809.
3. Koya T, Watanabe M, Kamada R, Hagiwara H, Nakao M, Kadosaka T, et al. Hybrid epicardial ventricular tachycardia ablation with lateral thoracotomy in a patient with a history of left ventricular reconstruction surgery. *J Cardiol Cases* 2021;**25**:37–41.
4. Li A, Hayase J, Do D, Buch E, Vaseghi M, Ajijola OA, et al. Hybrid surgical vs percutaneous access epicardial ventricular tachycardia ablation. *Heart Rhythm* 2018;**15**:512–519.