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Case Report

Trans-jugular vein approach for ablation of ventricular premature contractions originating from the tricuspid annulus

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ABSTRACT

A young-male underwent radiofrequency (RF) ablation of ventricular premature contractions (VPCs) of over 30,000/day and the morphology exhibited left bundle branch block and a superior axis, which indicated the VPCs originated from the inferior portion of the right ventricle (RV). While the PENTARAY catheter was placed under the tricuspid valve (TV), the earliest potential, which preceded the QRS onset by 34 ms, was recorded. Pace mapping there presented a very similar QRS morphology to the target VPC. However, the radiofrequency (RF)-catheter could not be placed under the TV even when a deflectable sheath was used, because the deflectable curve of the RF-catheter was larger than that of the PENTARAY. An over-the-vale RF application was not effective, so the trans-jugular approach with a deflectable sheath was indicated. The tip of the sheath was placed at a higher portion of the RV cavity to maintain an adequate distance for the RF-catheter tip to be deflected and placed under the TV. With this maneuver, the tip of the RF-catheter was successfully placed under the TV, which was confirmed by intracardiac ultrasound. Small atrial potentials and larger ventricular potentials could be recorded from the distal tip of the RF-catheter, which might indicate that the tip was placed at the TV annulus. An RF application at that site permanently abolished the VPC. Placing the tip of the RF-catheter under the TV by the femoral approach is very difficult in some cases. The trans-jugular approach with a deflectable sheath is one option for arrhythmias from the TV.

1. Introduction

A small number of cases of ventricular premature contractions (VPCs) originating from the tricuspid annulus (TA) have been reported [1], which would be difficult to ablate by a standard femoral vein approach and require an alternative approach from a superior approach in some cases [2–5]. Those previous reports described the precious details of the ablation of the superior portion of the TA [2,4]. However, the detailed techniques for the superior approach used to ablate arrhythmias originating from the inferior portion of the TA have not been fully discussed [3]. Here, we have described a case with a VPC originating from the inferior portion of the TA, which was successfully ablated by a trans-jugular approach and intracardiac ultrasound guidance.

2. Case report

A male in his late teens was referred to our hospital for an examination of VPCs causing chest discomfort. The 12-lead ECG presented normal sinus rhythm with frequent VPCs with a left bundle branch block morphology and superior axis (Fig. 1). No obvious structural abnormalities were evident on cardiac ultrasound and magnetic resonance imaging. Further, the brain natriuretic peptide level was within normal range. The number of VPCs was over 30,000/day and non-sustained ventricular runs of up to 8 beats at a rate of 160 beats/minute were also noted. The frequency of the VPCs decreased during the exercise tolerance test. The patient preferred ablation over drug therapy. Considering the patient's young age and the disadvantages of a long-term drug therapy, we decided that ablation was indicated. It was considered a IIB indication according to our domestic guidelines [6].

An electrophysiological study was performed guided by a CARTO sound system (Biosense Webster, CA, USA). A steerable

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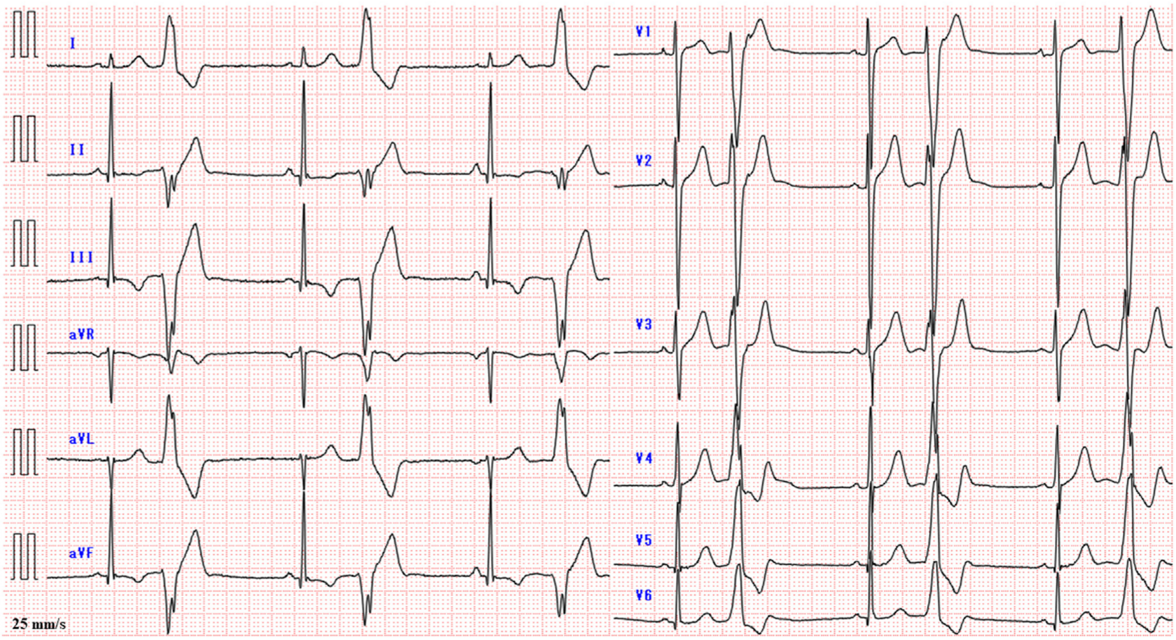

Fig. 1. Twelve-lead ECG during sinus and ventricular premature contractions.
The twelve-lead ECG reveals bigeminal ventricular premature contractions.

sheath (Agilis NxT, S curve, Abbott Laboratories, Chicago, IL, USA) and 8.5Fr sheath (Schwarz, Abbott Laboratories, Chicago, IL, USA) were inserted from the right femoral vein. Firstly, the three-dimensional geometry of the right ventricle (RV), right atrium, and TA was constructed by the CARTO sound system. Intracardiac ultrasound was also used to confirm the real-time catheter tip location. Then an activation map and pace map were constructed using a PENTARAY™ catheter (Biosense Webster, CA, USA) with an Agilis sheath. The earliest potential preceded the QRS onset by 34 ms and was found at the inferolateral aspect of the TA (Fig. 2). Pace mapping from that site produced a very similar QRS morphology to the target VPC (Fig. 2, bottom right panel, PASSO viewer, Biosense Webster, CA, USA). The PENTARAY™ catheter was maximumly deflected in the RV cavity and then pulled down to be successfully placed under the valve. A radiofrequency (RF) ablation catheter (THERMOCOOL SMARTTOUCH® SF, D/F curve, Biosense Webster, CA, USA) was inserted via the Agilis sheath, however, the RF catheter could not be placed under the valve (Supplementary Video 1) even when a deflectable sheath and an RF catheter with a D curve were maximumly deflected. The tip of the catheter was placed over the valve as close as possible to the earliest point under the valve, where a potential preceding the QRS onset by 26 ms was recorded (Supplementary Fig. 1). However, an RF application over the valve with a contact force value of 10g and 30 W of RF power was not effective, so a trans-jugular approach with a deflectable sheath (SupraCross® M curve, Baylis Medical, QC, Canada) was indicated. The tip of the sheath was placed in a higher portion of the RV cavity to maintain an adequate distance to allow the tip of the RF catheter to be deflected and placed under the valve (Fig. 3). Using this maneuver, the tip of the RF catheter was successfully placed under the valve leaflet, which was confirmed by real-time intracardiac ultrasound (Supplementary Video 2). Importantly, a small atrial potential was recorded from the distal tip of the catheter (Fig. 3B, bottom right), which indicated that the tip was located at the TV annulus. The contact force was stable at around 18 g and an RF application with a power of 25 W delivered at that site permanently abolished the VPC. Some consolidation RF applications were delivered with a target ablation index (AI; Biosense Webster, Diamond Barr, CA, USA) set at 500.

During a 12-month follow-up, he has not had any chest discomfort, and no VPCs have been documented by a 12-lead ECG or 24-h ECG recording.

Supplementary video related to this article can be found at https://doi.org/10.1016/j.ipej.2022.10.001

3. Discussion

VPCs from the inferior portion of the TA are not so common as compared to VPCs from the RV outflow tract [1]. The success rate of ablation would be lower than that of outflow tract VPCs [1]. Because the VPC originated from the perivalvular region [7], which is thicker than the other regions, the tip of the catheter should be located beneath the valve to create an adequate RF power delivery. However, in general, it is difficult to place the catheter tip beneath the valve leaflet with the standard femoral approach [4]. The effectiveness of the superior approach from the internal jugular or subclavian vein has been reported mainly in arrhythmias from the superior portion of the TA [2,4]. Further, there is some literature

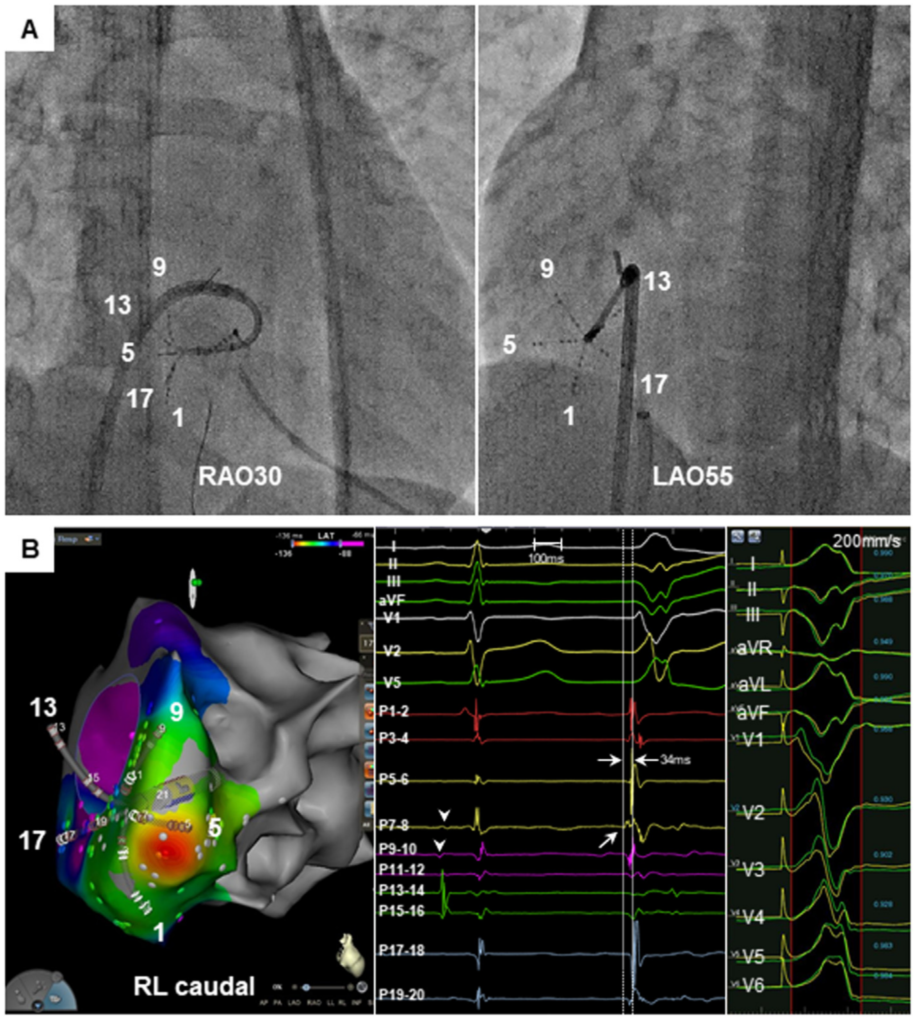

Fig. 2. Fluoroscopic view, three-dimensional map, intracardiac electrogram of the PENTARAY catheter, and 12-lead ECG during pace mapping.
A. The fluoroscopic view in the right and left anterior oblique views during PENTARAY mapping is presented. B. The three-dimensional map (left) and local potentials during a ventricular premature contraction (center) and the 12-lead ECG during pace mapping are presented (right). The earliest signal was able to be recorded at electrodes P7-8 (white arrow). Small atrial signals are recorded by electrodes P7-8, P9-10, and P11-12 (white arrowheads), which would indicate that that area was the tricuspid valve annulus. The numbers on the fluoroscopic and three-dimensional maps indicate the distal electrode numbers of the PENTARAY™ catheter.

describing the superior approach for ablation of arrhythmias from the inferior portion of the TA [3]. However, the detailed methods for using modern three-dimensional mapping systems, intracardiac ultrasound imaging, deflectable sheaths, and contact force sensing catheters have not been fully described.

A deflectable M curve sheath was used in this case to pass the sheath tip through the TA and be placed at a higher portion in the RV cavity to allow an adequate distance for the tip of the RF catheter to be bent and placed beneath the valve leaflet. Further, the direction of the RF catheter tip was adjusted by the sheath, and the RF catheter was deflected with a D curve and carefully advanced to the target site. The small atrial potential recorded by the tip of catheter suggested that the tip was placed on the valve annulus. Further, it was clearly recognizable that the tip was placed under the valve leaflet with real-time intracardiac ultrasound. The detailed three-dimensional construction of the ablation target region facilitated us to understand the complex anatomy of the peri-valvular region and allowed us to perform adequate catheter manipulation. Additionally, the average value of the contact force was stable, and the stability and adequate tissue contact of the tip were confirmed by intracardiac ultrasound, the three-dimension map, and fluoroscopic appearance. A higher tissue contact force, higher RF power, and/or longer RF application would create a larger and deeper lesion even if the RF was to be delivered from over the valve. However, to safely and effectively ablate the VPC, it is essential that the catheter tip be placed at the exact site of the arrhythmia origin with adequate tissue contact. The *trans*-jugular approach with a deflectable sheath is one option for safely and effectively ablating arrhythmias from the inferior portion of the TA.

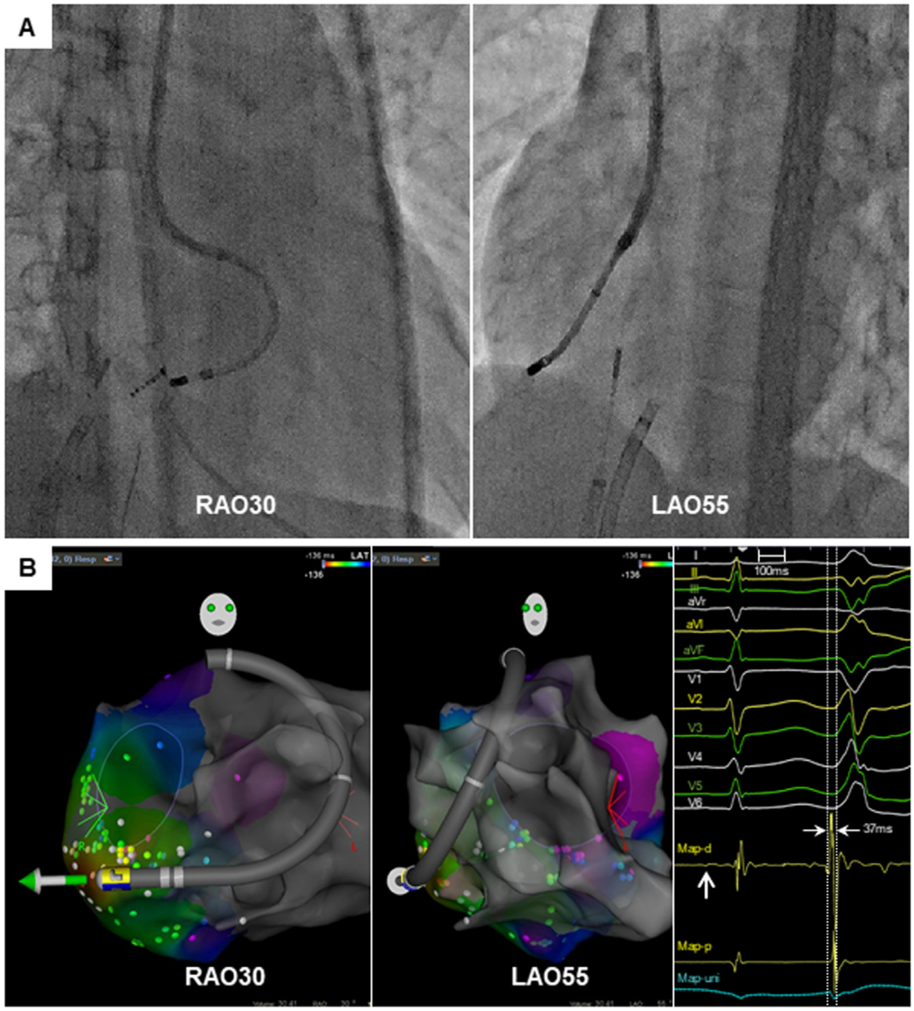

Fig. 3. Fluoroscopic views (A) and three-dimensional map (B) of the RF catheter and local potential at the successful site and ventricular premature contractions. The tip of the ablation catheter is placed on the tricuspid valve annulus, and a small atrial signal is recorded from the distal tip of the catheter (Map-d, white arrow) during sinus rhythm. Further, the local potential during a ventricular premature contraction preceded the QRS onset by 37 ms.

4. Conclusions

A case of successful ablation of VPCs originating from the inferior portion of the TA by a trans-jugular approach with a deflectable sheath was presented. The tip of the ablation catheter was able to be placed at the VPC origin beneath the valve leaflet, which could be confirmed by real-time intracardiac ultrasound.

Declaration of competing interest

The Section of Arrhythmia is supported by an endowment from Abbott Japan, Medtronic Japan, and Boston Scientific Japan. KH chairs the Section, and KF belongs to the Section. KF has received a scholarship donation from Biotronik JAPAN. However, all authors report no conflict of interest for this manuscript's contents.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ipej.2022.10.001.

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