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Case Report

A case of premature ventricular contractions originating from the papillary muscle in the right ventricle

Keitaro Senoo, MD*, Takayuki Otsuka, MD, Shinya Suzuki, MD, PhD, Koichi Sagara, MD, Takeshi Yamashita, MD, PhD

The Cardiovascular Institute, Tokyo, Japan

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ABSTRACT

A 45-year-old man with premature ventricular contractions (PVCs) underwent electrophysiological studies. Activation mapping using a noncontact electroanatomical mapping system indicated that the septal mid-apical region in the right ventricle was activated earliest. However, pace mapping did not match the activation mapping. Although the PVCs were successfully eliminated by applying radiofrequency current to the prepotential site preceding their QRS onset, a recurrence of PVCs with the same QRS morphology was observed at the 2-month follow-up examination, necessitating a second procedure. During the second procedure, echocardiography-guided electroanatomic mapping revealed centrifugal activation from the right ventricular mid-apical region on the septal portion of the anterior papillary muscle, but perfect pace mapping was not obtained at that site. With intracardiac echocardiography confirming good contact between the ablation catheter and papillary muscle, an irrigated radiofrequency current successfully eliminated the PVCs. This case indicates that the use of a guidance system may be feasible and useful for catheter ablation of PVCs originating from the right ventricular papillary muscle when there are discrepancies between activation mapping and pace mapping.

1. Introduction

Idiopathic premature ventricular contractions (PVCs) in the papillary muscles originate on or beneath the endocardium [1]. Achieving a stable catheter location for contact with these muscles can be challenging because they are actively involved in the repeated expansion and contraction of the heart. The CARTO 3D mapping system (CARTOSOUND, Biosense Webster, Diamond Bar, CA, USA) can be used with a real-time intracardiac echocardiography (ICE) probe and a CARTO™ navigation sensor (SOUNDSTAR, Biosense Webster) to facilitate image integration during ablation.

We report a case of PVCs originating from the right ventricular papillary muscle that were treated using radiofrequency catheter ablation with the integration of the CARTO 3D mapping system and ICE.

2. Case

A 45-year-old man with idiopathic PVCs accompanied by symptomatic palpitations underwent catheter ablation. Echocardiography demonstrated no evidence of structural heart disease. At baseline, monomorphic PVCs were frequent, with the following characteristics: QRS width of 130 ms, left bundle branch block, inferior axis, a transition zone in precordial leads V_3–V_4, and a positive QRS wave in lead I (Fig. 1B, right panel). To determine the origin of the PVCs, noncontact mapping (EnSite Navx system, St. Jude Medical, St. Paul, Minnesota) was performed with the EnSite Array catheter positioned in the right ventricular outflow tract. A 2-Hz high-pass filter was used with the virtual unipolar electrograms. During the procedures in the right ventricle, intravenous heparin was administered to maintain an activated clotting time of >250 s.

Although the electrophysiology study, based on virtual isopotential mapping with a noncontact mapping system (Fig. 1A), indicated that the PVCs originated in the mid-apical region of the right ventricular septum, their morphology at that site differed from that obtained via pace mapping in the same region (Fig. 1B). Radiofrequency current was applied to the sites that had the earliest local ventricular activation time relative to the QRS onset (17 ms before) and to those with a local unipolar QS pattern during the PVCs (Fig. 2A). However, radiofrequency ablation using a non-irrigated ablation catheter with a 4-mm tip (set at 30 W and with a target temperature of 55 °C) failed to eliminate the PVCs, although there was a slight change in the QRS morphology.

Subsequently, more detailed mapping was performed to identify the Purkinje potential preceding the QRS onset of the PVCs in their region of origin (Fig. 2B). Radiofrequency ablation was performed at the site of the earliest Purkinje potential preceding the local ventricular potential (Fig. 2C and D). When an acceleration or reduction of

* Correspondence to: Department of Cardiology, the Cardiovascular Institute, 3-2-19 Nishiazabu, Minato-Ku, Tokyo 106-0031, Japan. Tel.: +81 3 3408 2151; fax: +81 3 3408 2159.
E-mail address: swcqg251@yahoo.co.jp (K. Senoo).

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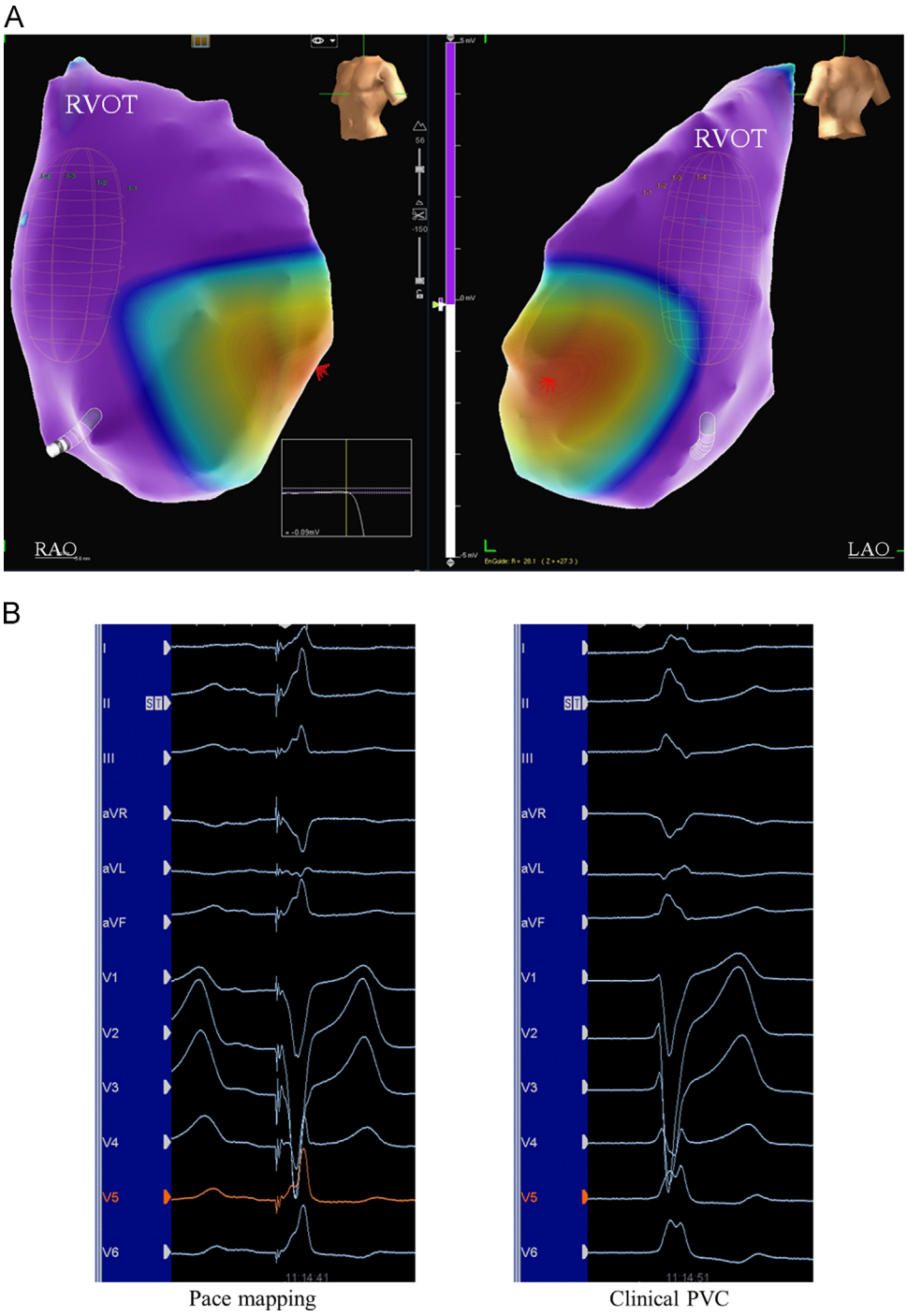

Fig. 1. A: Virtual unipolar isopotential mapping during premature ventricular contractions and B: pace mapping at the earliest activation site (left panel), clinical premature ventricular contraction (right panel). There were no correlations between the virtual unipolar isopotential mapping and the pace mapping. RVOT: right ventricular outflow tract, RAO: right anterior oblique view, and LAO: left anterior oblique view.

ventricular tachycardia (VT) or PVCs was observed at the beginning of the application, radiofrequency delivery was continued for an additional 60 s. Ultimately, the PVCs were eliminated within the vicinity of the earliest activation site. Thereafter, no ventricular arrhythmias could be induced, even after programmed electrical stimulation.

The second radiofrequency procedure was undertaken because of PVC recurrence 2 months after the first procedure. These PVCs had the same morphology as those targeted during the first procedure. Three-dimensional geometries of the papillary muscles and right ventricular chamber were reconstructed using CARTOSOUND™ during the PVCs (Fig. 3), and the SOUNDSTAR was positioned in the right ventricle for acquiring electrocardiogram-gated two-dimensional images. An ablation catheter (NAVISTAR THERMOCOOL, Biosense Webster) was then introduced to the right ventricle under the same heparin protocol as in the first procedure. Activation mapping in the right ventricle was performed during the PVCs using a catheter whose tip position was verified using ICE in real time. The activation map clearly indicated that the earliest ventricular activation site was the same as in the first procedure. At the activation site, ICE showed the anterior papillary muscle (Fig. 4A). Although pace mapping was performed from both the septal and free wall sides of the right ventricular papillary muscle, neither recorded perfect pace matching