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A case of successful radiofrequency catheter ablation of ventricular tachycardia from the noncoronary cusp

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ABSTRACT

Idiopathic ventricular tachycardias (VTs) originating from the non-coronary cusp (NCC) are very rare. The previous reports suggested NCC-VTs were characterized by a narrower QRS duration and smaller III/II ratio than VTs originating from other coronary-cusps. We present a rare case of an NCC-VT with a local fragmented potential recorded at the NCC inconsistent with the known ECG characteristics of NCC-VTs.

Introduction

Although there have been many reports regarding ventricular arrhythmias (VAs) originating from the left or right coronary cusps, previous reports of catheter ablation of idiopathic ventricular tachycardias (VTs) originating from the non-coronary cusp (NCC) are very rare. The previous reports suggested NCC-VTs were characterized by a narrower QRS duration and smaller III/II ratio than VTs originating from the other coronary-cusps. We present a rare case of an NCC-VT with a local fragmented potential recorded at the NCC inconsistent with the known ECG characteristics of NCC-VTs.

Case report

A 14-year-old male patient was referred to our hospital for catheter ablation therapy for a drug refractory wide QRS regular tachycardia with a heart rate of 200 bpm. The 12-lead ECG exhibited normal sinus rhythm and incomplete right bundle branch block on admission (Fig. 1A). The echocardiographic findings revealed a normal left ventricular function without any chamber enlargement or wall motion abnormalities. An electrophysiological study (EPS) was performed and electrode catheters were placed at the His bundle potential recording site and right ventricular apex (RVA). A multipolar electrode catheter was positioned inside the great cardiac vein to obtain the local activation around the anterior interventricular vein. A wide QRS regular tachycardia could be easily induced by burst pacing from the RVA (Fig. 1B). Dissociation between the atrial and ventricular activation suggested it was a VT. The VT cycle length (VTCL) was 300 ms. The QRS morphology during the VT exhibited an inferior axis and left bundle branch block (LBBB) pattern in the precordial leads and an R in lead I, R wave in lead II greater than that in lead III, and QS in lead V1. The 12-lead ECG during the VT demonstrated a relatively late transition. The earliest ventricular activation site was at the His bundle region (Fig. 2A). Mapping at the aortic cusps was performed because an earlier preceding local activation potential could not be obtained by mapping around the His bundle on the right ventricular septum. A local fragmented potential preceding the QRS onset by 43 msec was obtained by detailed mapping in the NCC (Fig. 2B). The onset of the local fragmented potential preceded the earliest ventricular activation by 15 msec around the His bundle region. Further, the unipolar electrogram exhibited a distinctive QS pattern (Fig. 2B). The local potential at that site during sinus rhythm before the ablation, exhibited an atrial and ventricular electrogram amplitude ratio (A/V ratio) at that site of <1.0. No His bundle electrogram could be recorded at the successful ablation site during sinus rhythm (Fig. 2C).

Pace mapping from the left ventricular outflow tract (LVOT) sometimes presents various QRS morphologies at the same pacing site, because of the preferential conduction or inability to obtain local myocardial capture despite high output pacing. The reproducibility of the QRS morphology by pace mapping from the LVOT could be poor. Further, the mechanism of those VAs is mainly due to triggered activity. For this reason, an evaluation by entrainment mapping could not be performed. We also tried to perform pace mapping, however, we could not obtain a good pace map due to the incessant onset pattern of the VT and the above reason.

Temperature controlled radiofrequency (RF) energy was applied with a 4 mm tip non-irrigated ablation catheter at the earliest site on the NCC during the VT as shown in Fig. 2B. Just after starting the RF energy application (0.64 s later), the VT terminated immediately. After the

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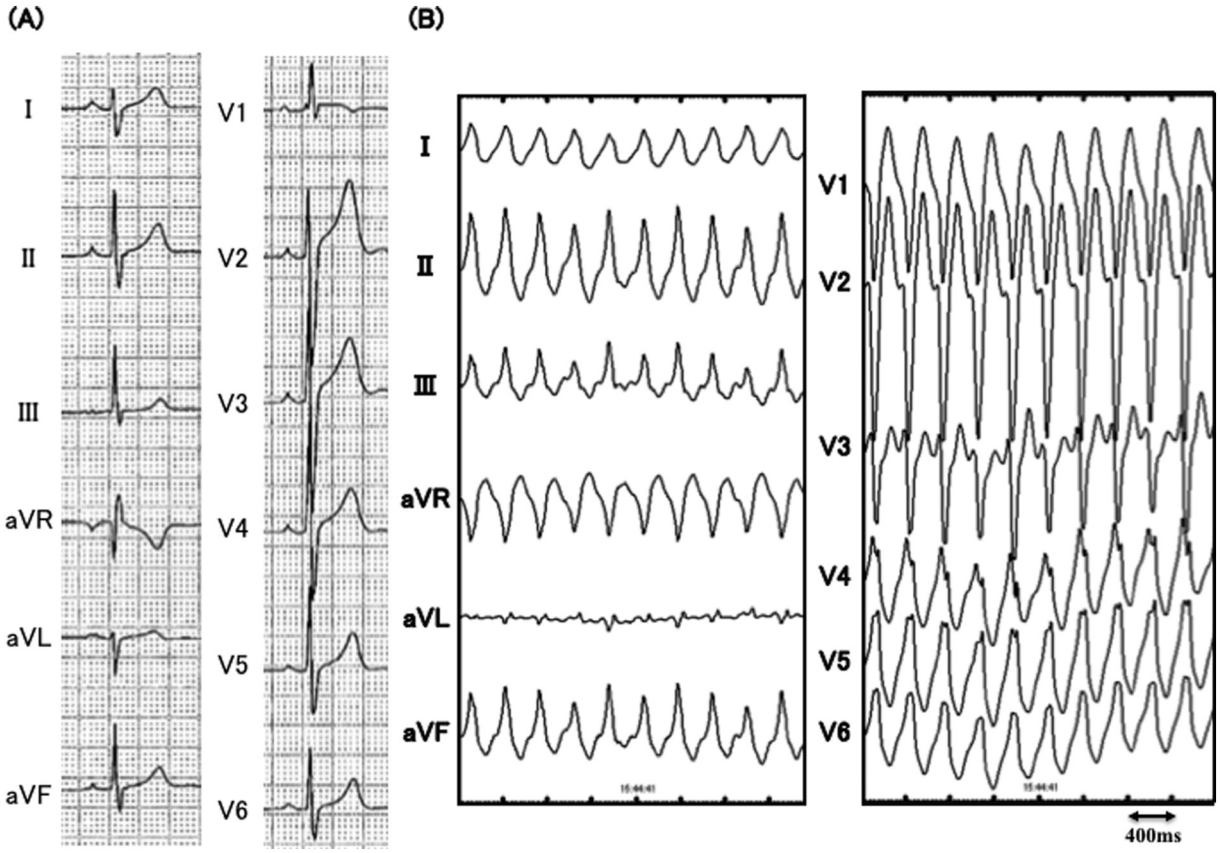

Fig. 1. (A) Surface 12-lead electrocardiogram (ECG) showing sinus rhythm and incomplete right bundle branch block. (B) The clinical ventricular tachycardia with a heart rate of 200–220 bpm. The QRS during the VT presented with an inferior axis and left bundle branch block (LBBB) pattern in the precordial leads, R in lead I, shallow S in aVL, R wave in lead II greater than that in lead III, and QS in lead V1. The 12-lead ECG during the VT demonstrates a relatively late transition.

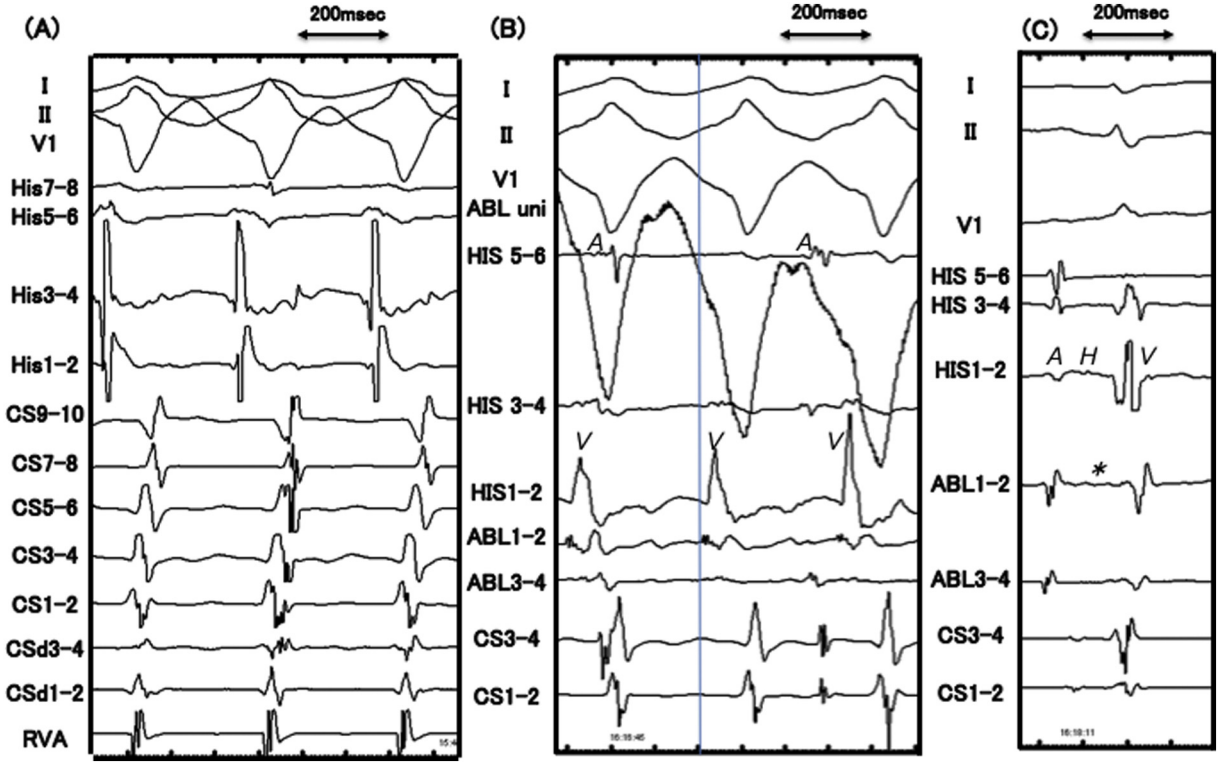

Fig. 2. (A) The intracardiac electrograms during the VT show the earliest ventricular activation site was the His bundle region. (B) The clinical VT was induced by pacing at that site on the NCC. The earliest ventricular activation was obtained in the His bundle region, 15 msec just after the onset of the fragmented local potential. The unipolar electrogram exhibits a distinctive QS pattern. The sustained VT terminated immediately after delivering a radiofrequency energy application at that site. (C) There was no His bundle electrogram recorded at the successful ablation site during sinus rhythm. *HBE(-).

successful ablation, the VT could no longer be induced by any ventricular stimulation.

Fig. 3 shows the right coronary cusp angiography and fluoroscopic catheter position of the successful ablation site at the NCC. The atrioventricular nodal conduction properties did not change after the ablation. The patient has had no VT recurrence for 12 months after the ablation.

Discussion

Although the VT-ECG findings demonstrated that the VT originated from near the His bundle region [1], we could perform a successful ablation of the VT at the NCC. The usefulness of catheter ablation at the NCC for atrial tachycardias (AT) has been reported for those originating from near the His bundle region [2]. However, ablation at the NCC for VAs (NCC-VA) originating from near the His bundle region is very rare. The anatomical relationship between the NCC and ventricular myocardium that was previously reported [3] indicated that a part of the NCC could be adjacent to the right ventricular myocardium at the junction of the right atrial and ventricular chambers. The NCC is located superior to the central fibrous body. The His Bundle penetrates through the central fibrous body and continues as the AV conduction bundle that then passes to the crest of the muscular ventricular septum, immediately beneath the membranous septum.

Several cases of VAs curable by ablation at the NCC have also been reported [4,5]. Mapping at the NCC usually reveals a local potential that consists of a large atrial potential and small ventricular potential [6]. In this case, however, the detailed mapping on the ventricular side of the NCC allowed us to obtain a larger ventricular electrogram amplitude than that of the atrium and also the earliest fragmented pre-potential preceding the ventricular electrogram as shown in Fig. 2B. This preceded the fragmented electrogram exhibiting a local electrocardiogram with a low amplitude and long duration of 45 msec. The local fragmented pre-potential may have indicated the local excitation region of the tachycardia origin and the following conduction inside the discontinuity of the local ventricular tissue caused by poor coupling between the cells [7], which could create a conduction delay to the left ventricle from the right ventricle. Yamada et al. [8]. previously reported that NCC-VTs were very rare and the QRS morphology of NCC-VAs was characterized by a narrower QRS duration of <150 ms along with an LBBB pattern and smaller III/II ratio of <0.65. This case was consistent with the QRS morphology previously reported as the characteristics of NCC-VAs, however, the VT-ECG in this case exhibited a wider QRS duration of 195 ms and larger III/II ratio of 0.76. It has also been reported that there are more frequent VA cases with curable ablation at the NCC, especially in young patients [9]. That finding could be related to the difference in the specific anatomical features between young and elderly patients such as a tortuous aorta. That is one reason why the NCC could be the successful ablation site for the VAs in adolescents. The detailed mapping of the NCC for NCC-VAs could allow us to find fragmented pre-potentials during VTs on the NCC, especially in young patients. It seems that the fragmented local potential recorded at the NCC could have represented the local activation of the myocardial tissue around His bundle region beneath the NCC that conducted to the exit site of the right ventricle.

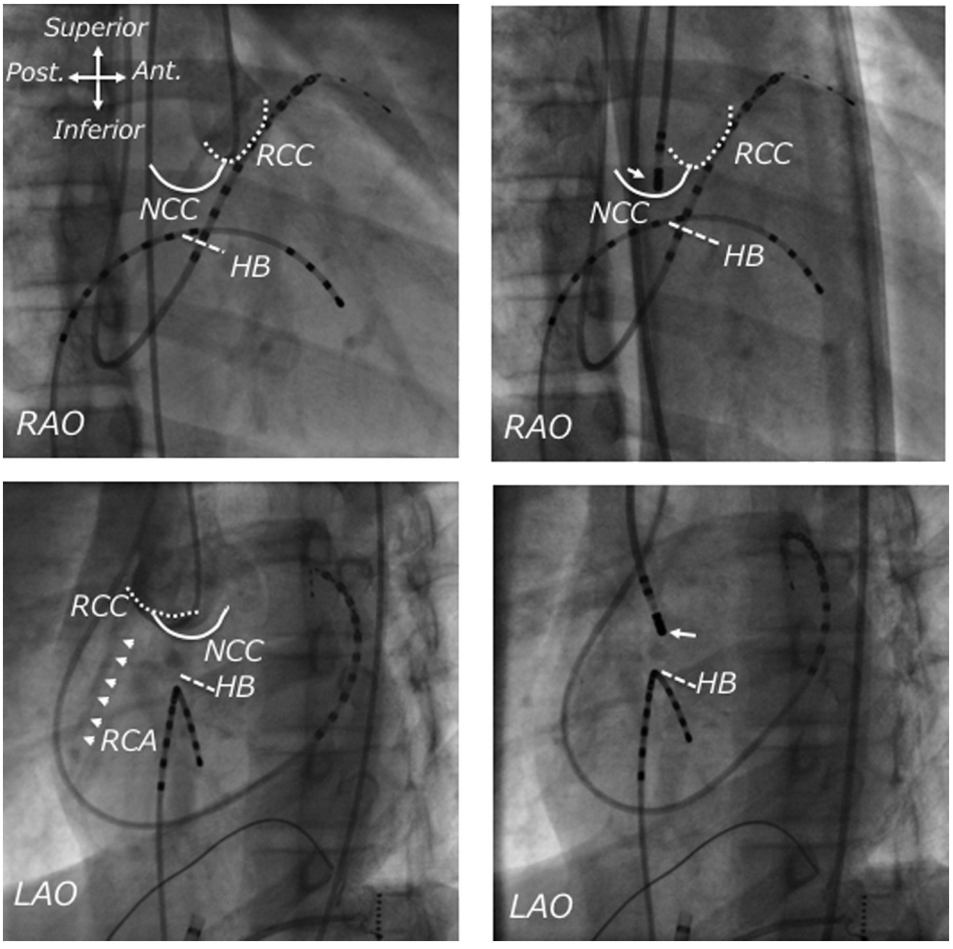

Fig. 3. Right coronary cusp angiography and the fluoroscopic catheter positions. The successful ablation site was at the NCC as shown by the arrows. The dotted line indicates the RCC rim, and the solid line indicates the NCC rim. The small arrows show the right coronary artery (RCA). HB indicates His Bundle.

Conclusion

This case suggested a curable ablation procedure with an approach to the NCC for a VT originating from near the His bundle region by targeting the origin with the conduction to the VT exit.

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