Original Article

Discrete Prepotential as an Indicator of Successful Ablation in Patients With Coronary Cusp Ventricular Arrhythmia

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Background—Although coronary cusp (CC) ventricular arrhythmia (VA) can be treated by catheter ablation, reliable indicators of successful ablation sites have not been fully identified.

Methods and Results—This study comprised 392 patients undergoing radiofrequency catheter ablation for outflow tract-VA at 3 institutions from January 2007 to August 2012. The successful ablation site was on the left CC or right CC in 35 (8.9%) of the 392 patients. In 9 (26%) of these 35 patients, a discrete prepotential was recognized, 5 of whom had left CC-VAs and 4 of whom had right CC-VAs. Radiofrequency catheter ablation was successful at the site of the prepotential in all 9 of these patients. The duration of the isoelectric line between the end of the discrete prepotential and the onset of the ventricular electrogram was 27±13 ms. The time from onset of the discrete prepotential at the successful ablation site on the CC to the QRS onset (activation time) was 69±20 ms (range, 50–98 ms). Pace mapping was graded as excellent at the successful ablation site in only 1 patient. No discrete prepotential was recorded in any successful right outflow tract-VA ablation case in this study.

Conclusions—A discrete prepotential was seen in 9 (26%) of 35 patients with CC-VA. In left and right CC-VA, the site of a discrete prepotential with ≥50 ms activation time may indicate a successful ablation site. (*Circ Arrhythm Electrophysiol*. 2013;6:898-904.)

Key Words: ablation ■ coronary cusp ■ discrete prepotential ■ ventricular arrhythmia

Radiofrequency catheter ablation (RFCA) is a safe and effective treatment for outflow tract-ventricular arrhythmias (OT-VA).[1–7] Approximately 15% of OT-VA require ablation within a coronary cusp (CC).[8] In the majority of OT-VA, including those with CC origin, successful ablation is achieved by both activation and pace mapping. However, when mapping is performed on the CC, one sometimes cannot achieve precise pace mapping because high output pacing is needed,[3] which unfortunately captures a relatively large area. Moreover, whenever RFCA is performed on the CC, there is a risk of severe complications such as coronary artery and aortic valve injury. Therefore, RFCA applications on the CC tend to be minimized for safety reasons. The aim of this study was to assess a new activation mapping-based indicator of successful ablation sites for CC-VA that might improve effectiveness and safety of RFCA.

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Methods

Study Population
This study comprised 392 patients who underwent successful RFCA for OT-VA at 3 institutions in Japan from January 2007 to August 2012. The 3 institutions were the Cardiovascular Center of Tsuchiura Kyodo Hospital in Tsuchiura, Musashino Red Cross Hospital in Tokyo, and the Heart Rhythm Center of Tokyo Medical and Dental University in Tokyo. Patients whose ablation failed (the anatomic location of their VA origin could not be determined) were not included in this study.

ECG Analysis
The peak deflection index (PDI)[9] and the transition zone (TZ) of R wave progression were recorded. The PDI was calculated as the interval from the QRS onset to the earliest peak deflection divided by total QRS duration in the inferior lead that presented the tallest R wave in the 12-lead ECG. For the purposes of quantitative analysis, if an electrocardiographic TZ was between 2 precordial leads, the value was taken to be at midpoint, for example, 2.5 if the zone was between V2 and V3.

Electrophysiological Study
After written informed consent was obtained from all patients and antiarrhythmic drugs were discontinued for ≥1 week before the study, an electrophysiological study was performed with the patient in the fasting, nonsedated state. A 7F quadripolar deflectable catheter with a 4-mm-tip distal electrode was advanced via percutaneous access through a femoral artery to the aortic sinus of Valsalva for

mapping at the CCs. Conventional mapping catheters with 4 electrodes were also introduced into the coronary sinus, the His bundle region, or the right ventricular OT. The coronary sinus catheter was inserted into the coronary sinus as deeply as possible to map within the great cardiac vein and the anterior interventricular cardiac vein. When the OT-VA originated in the left OT, the distal great cardiac vein and CCs were also mapped. When we mapped the OT to determine the optimal ablation site, activation time was defined as the interval from the onset of the discrete prepotential (DPP) to the QRS onset of the OT-VA, and pace mapping was performed at the same site. Pace mapping was graded as excellent for scores ≥11/12 in this study.

When the ablation catheter indicated a DPP, the interval between it and the ventricular electrogram was measured as shown in Figure 1A. Intracardiac bipolar electrograms filtered at 30 to 500 Hz and unipolar electrograms filtered at 0.1 to 100 Hz or 0.05 to 500 Hz were recorded by a computerized electrophysiological recording system (Bard LabSystem, CR Bard, Inc, Billerica, MA, or CardioLab System, GE Healthcare, Milwaukee, WI).

Radiofrequency Catheter Ablation

Tip temperature of the ablation catheter on the CC was maintained at 55°C during energy delivery for 60 seconds.[3,7] A 4-mm electrode ablation catheter (Blazer II, Boston Scientific Corp, Natick, MA, or Ablaze Fantasista, Japan Lifeline, Japan) was used for the RFCA on the CC. In the RFCA, the starting power was 30 W and maximum power setting was 50 W. Radiofrequency (RF) energy delivery was stopped if the CC-VA did not terminate within 20 seconds. RF energy was never delivered >3× to the same CC in any patient in this study to avoid complications such as injury to the coronary arteries.[3] We analyzed ventricular electrograms during sinus rhythm after successful ablation for the CC-VA. The location of the coronary artery ostia was identified with angiography before and after ablation to avoid coronary artery complications.

Statistical Analysis

All values were expressed as mean±SD and were compared by unpaired *t* test. Statistical significance was defined as *P*<0.05.

Results

Frequency of DPPs and ECG Findings in Patients With Them

The successful ablation site was on the left CC or right CC (RCC) in 35 (8.9%) of the 392 patients. In the remainder, the successful ablation site was in the right ventricular OT or left ventricular OT. Of the 35 patients whose successful OT-VA ablation site was on CC, DPPs were recognized in 5 left CC-VAs (5/35, 14.3%) and 4 RCC-VAs (4/35, 11.4%). Clinical characteristics of these 35 patients, including left ventricular ejection fraction, brain natriuretic peptide, the number of failed antiarrhythmic drugs, and underlying heart diseases, are given in Tables 1 and 2 by whether they had DPPs. PDI and TZ are also given in Tables 1 and 2. There was no significant difference between the patients with and without DPPs for the parameters studied. For example, the average PDI[9] of the 9 CC-VAs with a DPP was not different from that of the CC-VAs of the other 26 patients without (0.65±0.07 versus 0.64±0.03; *P*=0.6). In 4 of the 5 patients with left CC-VAs, the electrocardiographic precordial TZs ranged from V1 to V3 as described in previous reports[3,4]; the fifth patient had a TZ at V4. In the 4 patients with RCC-VAs, the precordial TZ ranged from V2-3 to V4-5 (mean TZ value, 3.25±0.9), similar to that for right OT-VA in general. Again, there was no
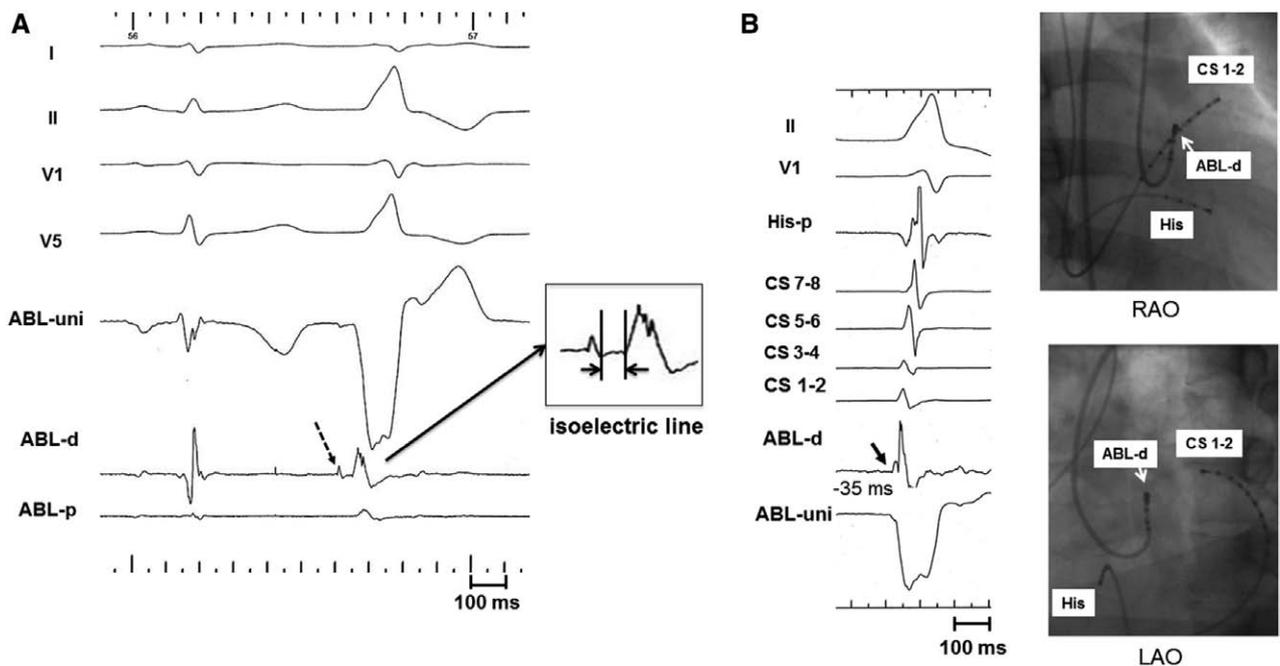

Figure 1. A, Measurement of the duration of the isoelectric line. The length of the isoelectric line between the end of the first component, which is a discrete prepotential (dashed arrow), and the onset of the second component, which is the ventricular electrogram, is measured as shown between the 2 arrows. This electrogram is from case 1. **B**, Activation mapping and fluoroscopic images of the catheter position near the coronary cusp (CC) in case 1. Electrograms recorded when the ablation catheter tip and CS catheter were both close to the CC, the eventual successful ablation site. The ablation catheter tip was just below the CC (endocardial site), and the CS catheter was in the distal great cardiac vein near the CC (epicardial site). ABL-d indicates distal bipolar electrogram of ablation catheter; ABL-p, proximal bipolar electrogram of ablation catheter; ABL-uni, unipolar electrogram of ablation catheter; CS, coronary sinus; LAO, left anterior oblique; and RAO, right anterior oblique.

Table 1.   Characteristics of OT-VA Patients With a Discrete Coronary Cusp Prepotential

Case	Sex	Age	No. of VPC	No. of Failed AADs	UHD	BNP, pg/mL	LVEF, %	PDI	TZ	CC
1	M	55	6615	1	…	15.7	74	0.64	V2	L
2	M	68	13841	1	OMI	185.3	30	0.63	V2	L
3	M	41	42072	3	…	75.9	62	0.68	V2-3	L
4	M	50	46094	1	…	47.2	62	0.66	V1	L
5	F	62	31012	1	…	120	63	0.61	V4	L
6	M	25	40929	0	…	5.7	55	0.52	V4-5	R
7	F	58	28659	0	…	53	55	0.68	V3	R
8	M	67	37443	2	…	72.9	58	0.67	V2-3	R
9	M	71	37542	0	…	113*	64	0.76	V3	R
Mean±SD	F/M:2/7	55.2±15	31579±13346	1.0±1.0		72.0±58.2 (n=8)	58±12	0.65±0.07	2.7±1.1	L/R:5/4

Ventricular premature contraction (VPC) count in 24 h. AADs indicates antiarrhythmic drugs; BNP, brain natriuretic peptide; CC, laterality of coronary cusp; LVEF, left ventricular ejection fraction; OMI, old myocardial infarction; OT-VA, outflow tract-ventricular arrhythmia; PDI, peak deflection index; TZ, transitional zone; and UHD, underlying heart diseases.

*NT-pro BNP.

significant difference in the TZ value between the CC-VAs with and without DPPs (2.7±1.1 versus 2.1±1.0; $P=0.12$). No DPP was observed in any of the successful ablation cases of right or other left OT-VA patients in this study.

Electrophysiological Study

The duration of the isoelectric line between the end of the DPP and the onset of the ventricular electrogram was 27±13 ms (Tables 3 and 4). The activation time (time from onset of the DPP recorded at the successful ablation site on the CC to QRS onset) was 69±20 ms (range, 50–98 ms) as shown in Figures 1 and 2. That is, successful ablation was achieved when a DPP with an activation time of ≥50 ms was recognized, despite the fact that pace mapping scores at the successful ablation site were poor with the exception of 1 patient (case 3, Figure 3).

Examples of electrograms recorded in close proximity to successful ablation site in the CC, but not in the CC, are shown in Figure 1B (from the same patient as in Figure 1A) and Figure 4 (case 7). In Figure 1B, the ablation catheter tip was just below the CC (endocardial site), and the coronary sinus catheter was in the distal great cardiac vein near the CC (epicardial site). There is a distinct potential (arrow) recorded by the ablation catheter, but it is followed immediately (35 ms later) by the ventricular potential, leaving no room for an isoelectric line, in contrast to the 84 ms activation time recorded at the successful ablation site in the CC (Figure 1A). No other potentials, including Purkinje potentials, were observed at this site. In Figure 4, a 98-ms activation time is recorded at the successful ablation site in the RCC, and in the endocardium beneath it, instead of an isoelectric line, Purkinje and continuous low-voltage potentials are observed.

When pace mapping was performed in the CC, a relatively high pacing output of >7 volts with a 2-ms pulse width was consistently needed in the 35 patients with CC-VA.

The activation time was significantly greater in OT-VA patients with a discrete CC prepotential than in those without a discrete CC prepotential. Conversely, the pace mapping score was significantly lower in OT-VA patients with a discrete CC prepotential than in those without a discrete CC prepotential as shown in Table 4.

Delayed Potential

A delayed potential that followed the terminal portion of the QRS during sinus rhythm after successful ablation was recognized in 3 (33.3%; 1 RCC, 2 left CC) of the 9 CC-VA patients with DPPs (Figure 5, solid arrows). Inspection of the corresponding potentials before ablation showed that ablation had delayed these potentials by 33±12 ms (Table 3).

Follow-Up

There were no complications involving the coronary artery nor aortic valve injury in any of the patients with CC-VA in this study. All 9 patients, as well as the patients without DPPs, remained free of arrhythmias in the absence of antiarrhythmic drugs during a follow-up period of 32±24 months.

Table 2.   Comparison of Characteristics Between OT-VA Patients With and Without Discrete Coronary Cusp Prepotential

	Sex	Age	No. of VPC	No. of Failed AADs	UHD	BNP, pg/mL	LVEF, %	PDI	TZ	CC
DPP+ (n=9)	F/M:2/7	55.2±15	31579±13346	1.0±1.0	OMI:1	72.0±58.2 (n=8)	58±12	0.65±0.07	2.7±1.1	L/R:5/4
DPP− (n=26)	F/M:14/12	54.5±19	22214±8989	0.96±1.0	OMI:1, AR:1	60.2±82.8	63±6	0.64±0.03	2.1±1.0	L/R:21/5
P value	NS	NS	NS	NS		NS	NS	NS	NS	NS

AADs indicates antiarrhythmic drugs; AR, aortic regurgitation; BNP, brain natriuretic peptide; CC, coronary cusp; DPP, discrete prepotential; LVEF, left ventricular ejection fraction; NS, not significantly different between patients with and without DPP; OT-VA, outflow tract-ventricular arrhythmia; PDI, peak deflection index; TZ, transitional zone; UHD, underlying heart diseases; and VPC, ventricular premature contraction.

Table 3. Electrophysiologic Study Characteristics in OT-VA Patients With a Discrete Coronary Cusp Prepotential

Case	AT, ms	P-V Duration, ms*	PM Score	Delayed Potential, ms
1	84	32	0	–
2	50	22	4	–
3	50	20	12	40
4	97	46	2	20
5	52	18	1	–
6	66	18	2	–
7	98	50	2	40
8	75	20	2	–
9	50	16	0	–
Mean±SD	69±20	27±13	2.8±3.7	33±12 (n=3)

– indicates loss of second peak; AT, activation time; OT-VA, outflow tract-ventricular arrhythmia; P-V duration, time from the end of prepotential to ventricular electrogram onset; PM score, pace mapping score; delayed potential, increase in delay between peak of the potentials (see solid arrows in Figure 5) before and after successful ablation, recorded in sinus rhythm.

*See Figure 1.

Discussion

Presence of a 2-component electrogram at the site of successful ablation on the CC has been reported previously in CC-VA.[4,5] However, these reports did not assess the prevalence of such prepotentials nor their relationship to successful ablation. Although OT-VA patients with discrete great arterial potentials have been reported,[10] a distinct discrete isoelectric line between the DPPs and ventricular electrograms as shown in figures has not been recognized before. There were 3 major findings in this study. One, we found that >1 in 4 (9/35) patients whose successful ablation site was in the CC displayed DPPs. DPPs were not observed outside the CC. Second, we discovered the presence of an isoelectric line between the end of the DPP and the ventricular electrogram in all 9 of these patients (Figures 1A, 2, 4, and 5). Indeed, we used the existence of the isoelectric line to define what we called a DPP. Third, all DPPs observed on the CC displayed an activation time (time from DPP onset to QRS onset) ≥50 ms (average, 69±20 ms), although almost all pace mapping scores at the sites were poor (Table 4). To reiterate, whenever a DPP with ≥50-ms activation time was recorded, RFCA was successful in the present study regardless of pace mapping score. (As might be expected, in patients without DPP, good pace mapping scores were associated with successful ablation.)

Table 4. Comparison of Electrophysiologic Study Characteristics Between OT-VA Patients With and Without a Discrete Coronary Cusp Prepotential

	AT, ms	PM Score
DPP+ (n=9)	69±20	2.8±3.7
DPP– (n+26)	33±7.7	9.6±2.2
P value	<0.0001	<0.0001

AT indicates activation time; DPP, discrete prepotential; OT-VA, outflow tract-ventricular arrhythmia; and PM score, pace mapping score.
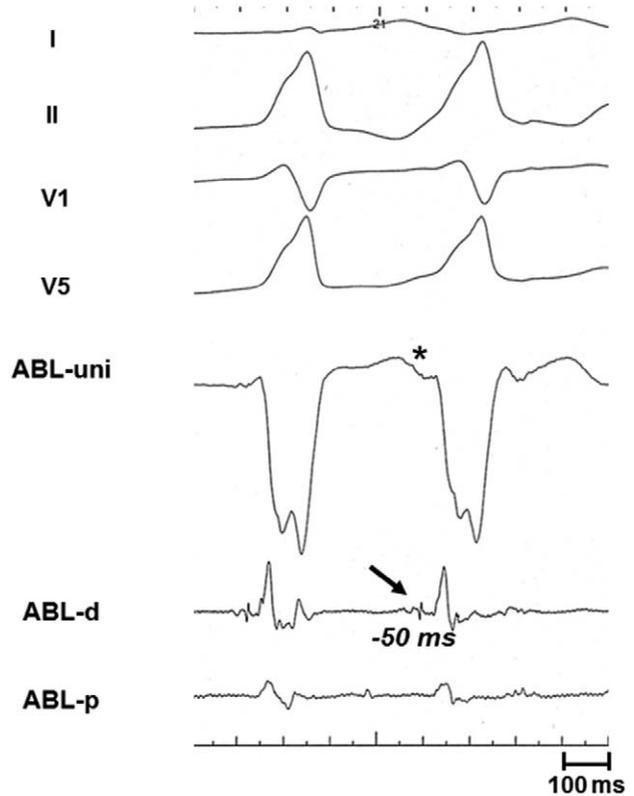

Figure 2. A discrete prepotential recorded in case 3. Four surface ECG leads and the unipolar and bipolar electrograms are shown. A discrete prepotential on the left CC at the successful ablation site was recorded and is indicated by the arrow. The discrete prepotential preceded QRS onset by 50 ms. Also, note that the small notch in the unipolar electrogram (asterisk) occurs at the same time that the discrete prepotential is recorded. Catheter identifiers as per Figure 1. ABL-d indicates distal bipolar electrogram of ablation catheter; ABL-p, proximal bipolar electrogram of ablation catheter; and ABL-uni, unipolar electrogram of ablation catheter.

ECG Characteristics

The PDI[9] was >0.6 except in 1 patient (Tables 1 and 2). We surmised that in 9 patients CC-VAs had originated from an epicardial site similar to the other 26 patients with CC-VAs.[7] Neither did these 9 patients have any special ECG characteristics, including position of the transitional zone in the chest leads, that could distinguish them from the other 26 patients with CC-VAs.

Detailed Mapping Is Necessary

Detailed mapping was required to reveal the critical DPP. We found that the DPP could easily become small and less defined if the mapping catheter was shifted a small distance (Figure 6). We strongly think that taking a few extra minutes to map the CCs carefully—they are small compared with that of the atrium and ventricle—is worth the effort because of the successful ablation it will lead to. That is not to say that one can find a DPP in all successful cases with higher sensitivity catheters and enough time because of physical characteristics of the CC and spatial relationship between the CC and VA focus.

Origin of the Discrete Prepotential

The presence of an isoelectric interval between the DPP and ventricular electrogram seems to be qualitatively similar to
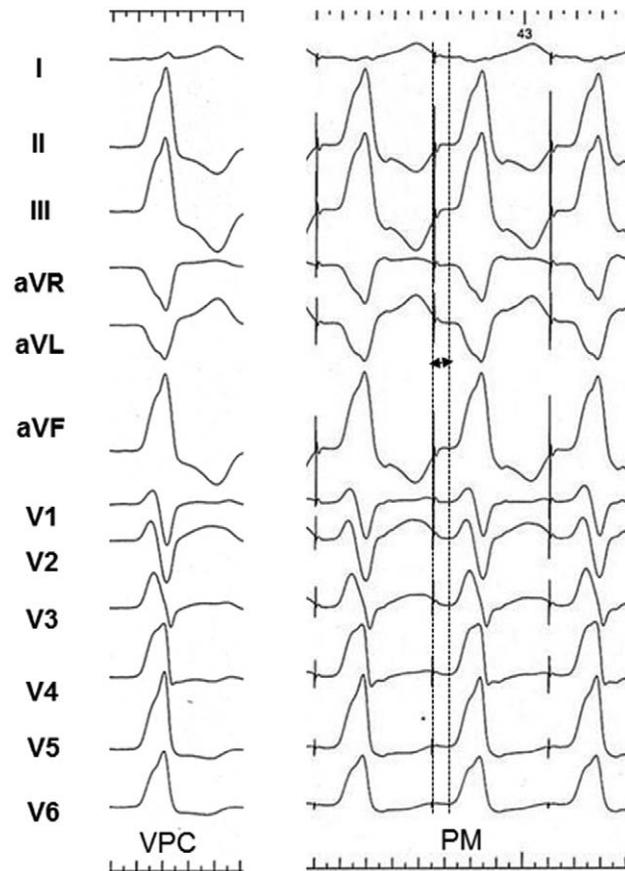
Figure 3. Pace mapping in case 3. Pace mapping with a stimulus-QRS interval of 50 ms was excellent when pacing was delivered at the same site as where the discrete prepotential was recorded. See text for further discussion. PM indicates pace mapping.

that between the His bundle electrogram and ventricular electrogram recorded by electrodes placed in the His bundle area. In other words, the first component, which was the DPP, was

insulated from the second component, the ventricular electrogram, just as the His bundle component is insulated from the ventricular myocardium. We speculate that a dead-end tract at the top of the ventricular septum is a plausible explanation for the DPP we observe. Kurosawa and Becker[11] reported an example of a right ventricle from an infant showing a normal conduction axis except for a dead-end tract, which coursed anteriorly beneath the aortic valve and then disappeared. The spiky potential shown in Figure 4 which seemed to originate from the normal conduction system also supports the speculation of a dead-end tract because it was recorded just inferior to the successful ablation site. It is known that RF application in the CC does not ablate the valve tissue itself, but rather the myocardium of the roof of the ventricular septum just beneath the valve,[12] as described in an anatomic study by Anderson.[13]

Mechanism of Poor Pace Mapping Scores at Successful Ablation Sites

The DPP was a tiny electrogram, so it was difficult to capture the site exactly with normal pace mapping stimuli. For pacing, a relatively high voltage of >7 V with a 2-ms pulse width was needed to capture the site. As we stated in the results, there was only 1 patient (case 3) in whom we achieved a pace mapping score of ≥11. Based on this high score, and because the stimulus-QRS interval of 50 ms was identical to the interval from the DPP to QRS onset (Figures 2 and 3), we think it is likely that capture by the pacing stimulus was narrowly limited to the site of the DPP, the origin of the CC-VA. Conversely, it is probable that in the remaining 8 patients (Tables 3 and 4), the score when pacing at the site of successful ablation was poor because a greater area was captured than desirable. Therefore, we think that in patients with CC-VA with a DPP activation mapping should take priority over pace mapping, especially when a DPP with an activation time of ≥50 ms is recognized.
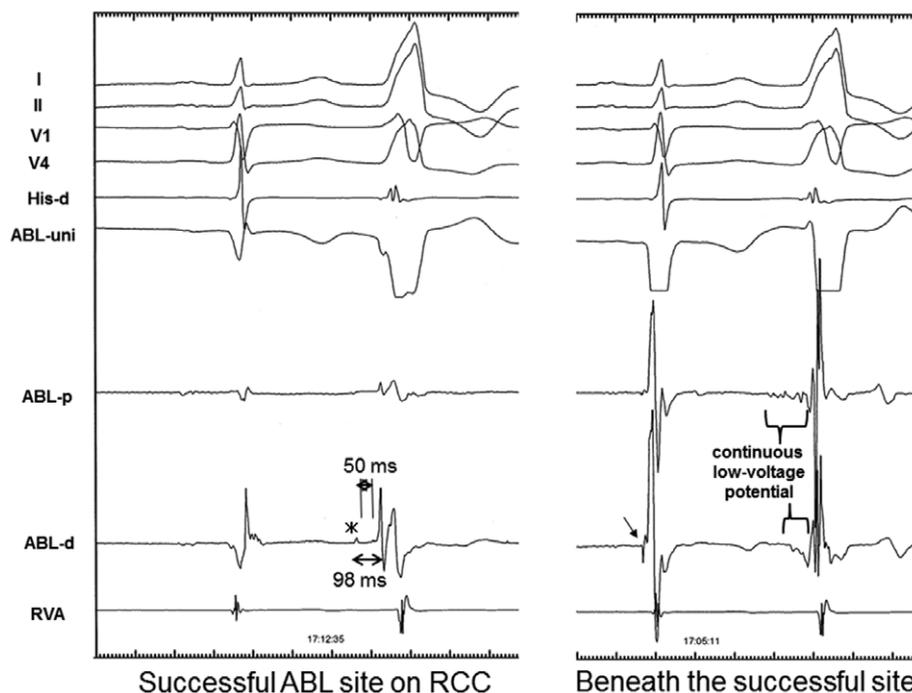

Figure 4. Successful ablation site in case 7. The arrow indicates a Purkinje potential, and the asterisk indicates the discrete prepotential. ABL-d indicates distal bipolar electrogram of ablation catheter; ABL-p, proximal bipolar electrogram of ablation catheter; ABL-uni, unipolar electrogram of ablation catheter; RCC, right coronary cusp; and RVA, right ventricular apex.
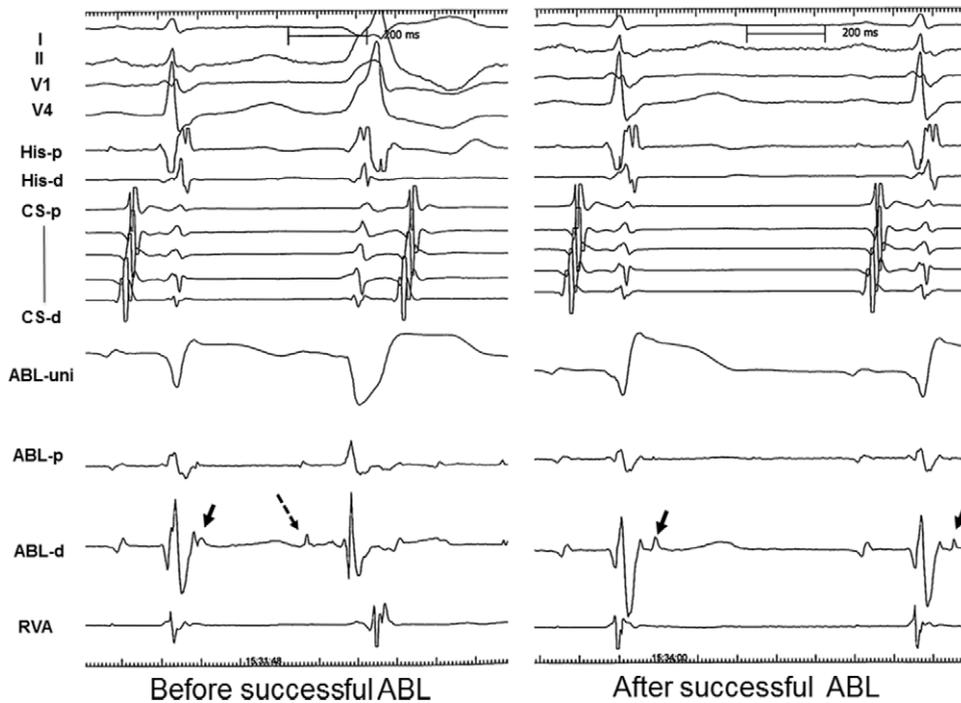
Before successful ABL   After successful ABL

Figure 5. Delayed potential observed during sinus rhythm after successful ablation in case 4. Successful ablation delayed these potentials by 20 ms as shown by the solid arrows in the **right**. The dashed arrow indicates the discrete prepotential in this case. ABL-d indicates distal bipolar electrogram of ablation catheter; ABL-p, proximal bipolar electrogram of ablation catheter; ABL-uni, unipolar electrogram of ablation catheter; CS, coronary sinus; and RVA, right ventricular apex.

Existence of a Tract Related to the CC-VA

In 3 of the 9 patients displaying DPP, namely patients 3, 4, and 7, we observed appearance of a delayed potential after successful ablation (Figure 5) that was similar in morphology to the now absent DPP, suggesting that the timing of the DPP had shifted to a later time. In a study of 23 patients with idiopathic ventricular tachycardia who received catheter ablation in the left CC, Tada et al[7] observed presystolic potentials before the QRS complex that he termed P1, which was usually recorded within the CC. These P1 prepotentials seem to be different from what we have termed DPP (Figures 1A, 2, 4, and 5), in that activation time was short (average, 27 ms) because they had no discernible isoelectric line but instead were followed immediately by the ventricular electrogram. P1 was recorded both at successful and unsuccessful ablation sites (P=0.5).[7] In contrast, Tada et al[7] also observed potentials in sinus rhythm that followed the ventricular electrogram that he termed P2, which seem to correspond to the delayed potentials as we observed in this study. They found that de novo appearance of a P2 potential or a delay in the pre-existing P2 potential after RFCA was more often observed at successful ablation sites than at unsuccessful ablation sites. Another case report noted that the prepotential always followed the preceding ventricular activation with a constant coupling interval.[14] We also observed a constant coupling interval between preceding ventricular activation and DPP in all 9 of our patients.

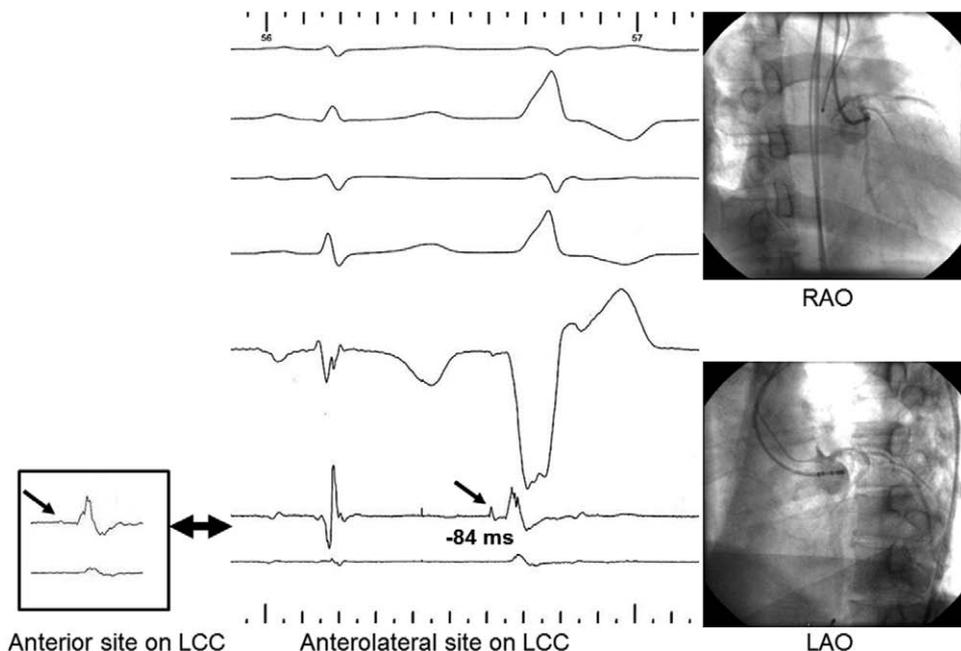Anterior site on LCC   Anterolateral site on LCC   LAO

−84 ms

RAO

Figure 6. Sensitivity of prepotential to catheter tip location at the successful ablation site. Detailed mapping on the left coronary cusp (LCC) in case 1 shows that when the tip of the mapping catheter was located at an anterior site on the LCC, a tiny blunt discrete prepotential was observed (arrow, framed panel). This became sharper and taller after the tip of the catheter was positioned at an anterolateral site, which was the successful ablation site, as indicated by the arrow (**center**). In the fluoroscopic image, the tip of the ablation catheter is at an anterolateral site on the LCC. LAO indicates left anterior oblique; and RAO, right anterior oblique.

We think that the DPP represents activation of a tract connecting the arrhythmia focus to the ventricular myocardium. If both a DPP before RFCA and a delay in its appearance after RFCA are seen, we think that a tract of preferential conduction[6] may be contributing to the CC-VA, but a more detailed study would be necessary to prove such a mechanism. The significance of presence of DPP and delay (such as P2 in the report by Tada et al[7]) in its appearance after RFCA is that if it can be proved to be a sufficient indicator of successful ablation, then RFCA applications to the CC could be terminated once this sign is observed, making unnecessary any further energy application.

Conclusions

A DPP was seen in 9 (26%) of 35 patients with CC-VA. In left CC-VA or RCC-VA, the site of a discrete prepotential with ≥50-ms activation time may be an indicator of a successful ablation site and facilitate successful ablation of CC-VAs.

Disclosures

None.

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CLINICAL PERSPECTIVE

Approximately 9% to 15% of patients with outflow tract ventricular arrhythmia had coronary cusp ventricular arrhythmia (CC-VA). Although CC-VA can be treated by radiofrequency catheter ablation, reliable indicators of successful ablation sites have not been fully identified. In the majority of outflow tract ventricular arrhythmia, including those with CC origin, successful ablation is achieved by both activation and pace mapping. However, when mapping is performed on the CC, one sometimes cannot achieve precise pace mapping because high output pacing is needed. Moreover, whenever radiofrequency catheter ablation is performed on the CC, there is a risk of severe complications such as coronary artery and aortic valve injury. We assessed a new activation mapping-based indicator of successful ablation sites for CC-VA that might improve effectiveness and safety of radiofrequency catheter ablation. A discrete prepotential as an indicator of successful ablation was seen in 9 (26%) of 35 patients with CC-VA. The duration of the isoelectric line between the end of the discrete prepotential and the onset of the ventricular electrogram was 27±13 ms. In left or right CC-VA, the site of a discrete prepotential with ≥50-ms activation time may be an indicator of a successful ablation site and facilitate successful ablation of CC-VAs even if pace mapping score at the site is poor. In such cases, we note that detailed mapping is required to reveal the critical discrete prepotential.

Circulation
Arrhythmia and Electrophysiology

Discrete Prepotential as an Indicator of Successful Ablation in Patients With Coronary Cusp Ventricular Arrhythmia

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Correction

In the article "Discrete Prepotential as an Indicator of Successful Ablation in Patients With Coronary Cusp Ventricular Arrhythmia" by Hachiya et al, which was published in the October 2013 issue (*Circ Arrhythm Electrophysiol*. 2013;6:898–904), corrections were needed.

Alterations have been made to the Figure 6 legend. The legend now reads as follows: "Sensitivity of prepotential to catheter tip location at the successful ablation site. Detailed mapping on the left coronary cusp (LCC) in case 1 shows that when the tip of the mapping catheter was located at an anterior site on the LCC, a tiny blunt discrete prepotential was observed (arrow, framed panel). This became sharper and taller after the tip of the catheter was positioned at an anterolateral site, which was the successful ablation site, as indicated by the arrow (center). In the fluoroscopic image, the tip of the ablation catheter is at an anterolateral site on the LCC. LAO indicates left anterior oblique; and RAO, right anterior oblique."

Also, an in-text citation has been added for Figure 1A in this sentence: "There is a distinct potential (arrow) recorded by the ablation catheter, but it is followed immediately (35 ms later) by the ventricular potential, leaving no room for an isoelectric line, in contrast to the 84 ms activation time recorded at the successful ablation site in the CC (Figure 1A)."

The authors apologize for the revisions and omissions.

The online version of the article has been corrected.