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CASE REPORT

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Delineation of the right ventricular septal activation during a right bundle branch origin accelerated idioventricular rhythm

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Abstract

Accelerated idioventricular rhythm (AIVR) originating from the right bundle branch (RBB) (RBB-AIVR) is a rare ventricular arrhythmia. We delineated RBB and myocardial activation separately during RBB-AIVR, which revealed the spatial relationship of the AIVR origin, preferential pathway, and breakout site. Radiofrequency ablation to the preferential pathway successfully eliminated this arrhythmia.

KEYWORDS

accelerated idioventricular rhythm, catheter ablation, high-density mapping, preferential pathway

1 | CASE REPORT

A 36-year-old male with no significant medical history presented with episodes of palpitations. When symptomatic, a wide QRS tachycardia with left bundle branch block, left/inferior axis, and atrioventricular dissociation was observed. The QRS interval was 120 ms and fusion with sinus rhythm shortened the QRS interval (Figure 1A). Those findings suggested the mechanism of this tachycardia was accelerated idioventricular rhythm (AIVR). Transthoracic echocardiography revealed normal ventricular size and normal ejection fraction without any abnormal wall motion.

During the procedure, AIVR was observed in an incessant form. The AH interval and HV intervals were 86 ms and 44 ms, respectively. The grid catheter (HD Grid Advisor, Abbott, Abbott Park) recorded the RBB potential (Figure 1B). Figure 1C shows a continuous 3-beat recording of sinus rhythm, mechanical premature ventricular contractions, and AIVR. The conduction sequence of the RBB was identical during sinus rhythm and AIVR. On the contrary, the polarity of the His bundle potential was reversed during the AIVR, suggesting retrograde His activation. The origin of the AIVR was speculated to exist between the His bundle and the recording site of the RBB. A high-density activation map was delineated with an Ensite system (Precision, Abbott) during the AIVR. In the first map, the local electrograms were annotated with the RBB activation. It exhibited a focal pattern from the septum 13 mm distal to the His potential recording site. At the earliest site (origin), the RBB potential preceded the QRS onset by 42 ms (Figure 2A).

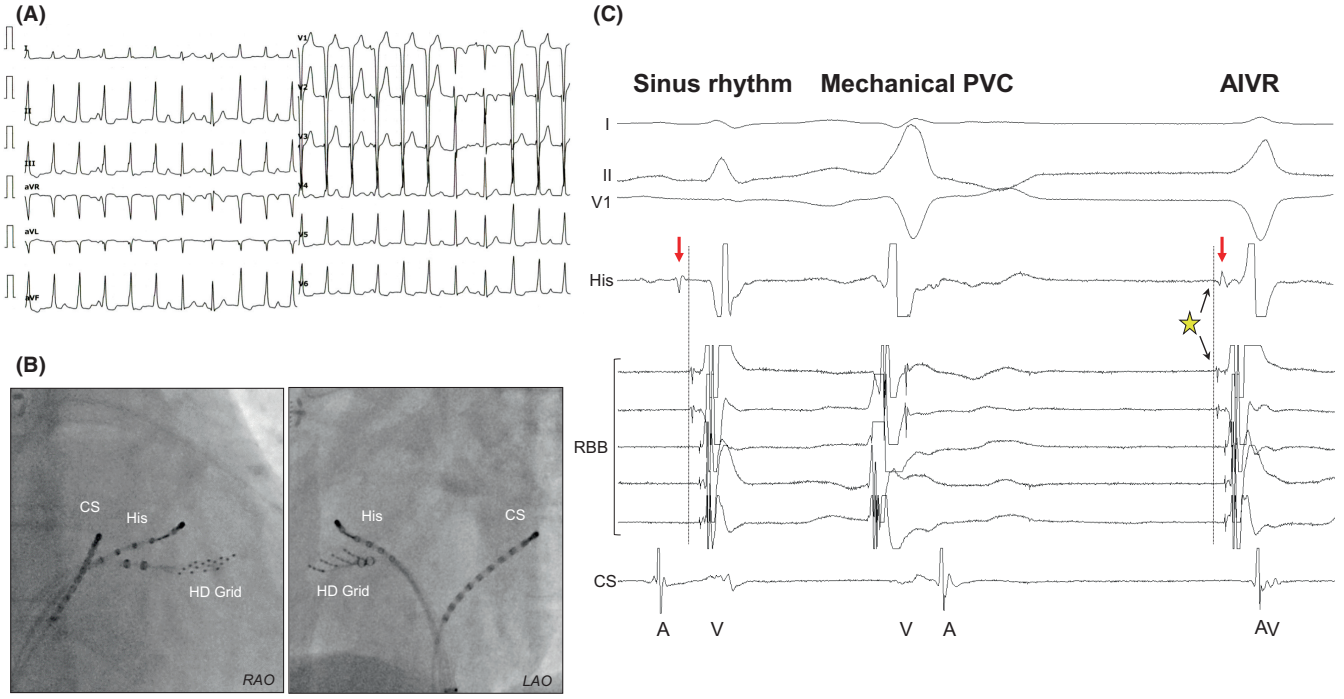

FIGURE 1 Reverse polarity of the His bundle potential during AIVR. (A) Twelve-lead ECG during AIVR. (B) The RBB potentials were recorded by a grid catheter. (C) A 3-beat recording of sinus rhythm, a mechanical PVC, and AIVR. AIVR, accelerated idioventricular rhythm; CS, coronary sinus; PVC, premature ventricular conduction; RBB, right bundle branch.

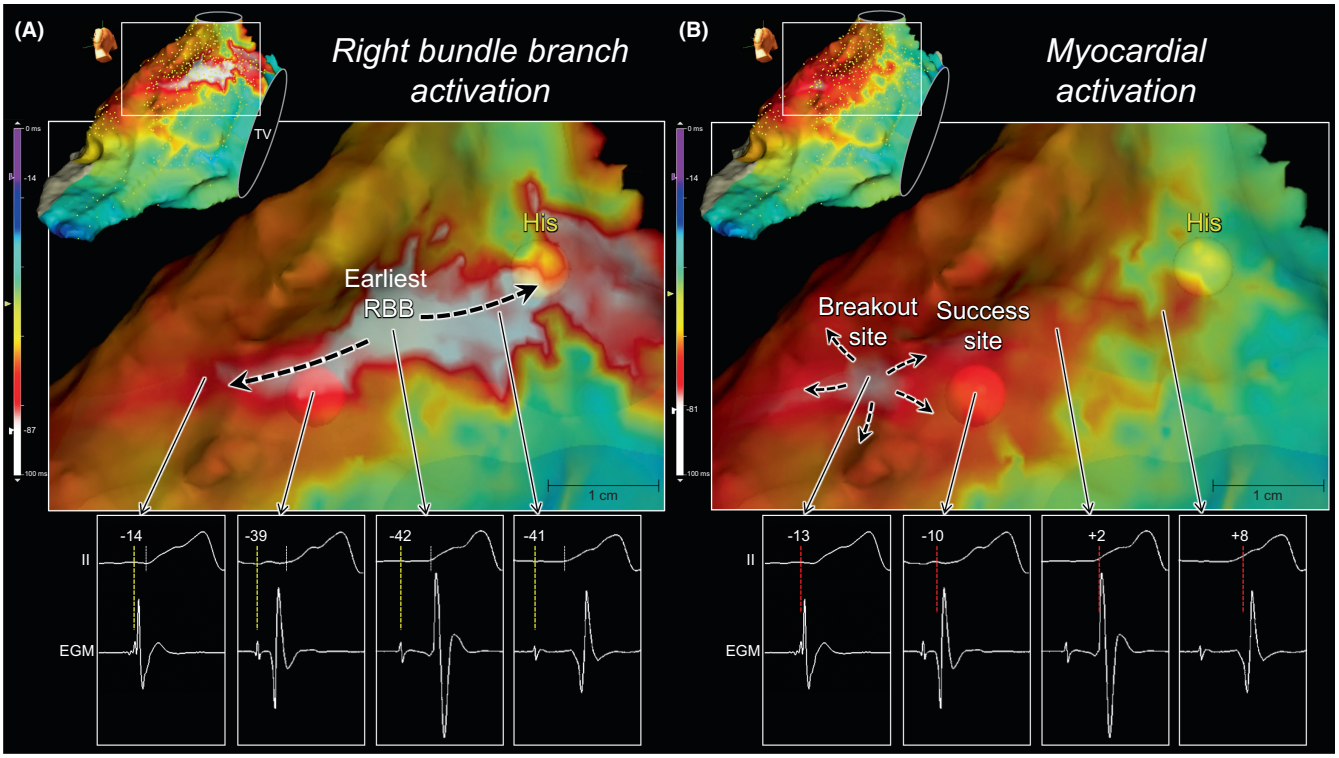

FIGURE 2 High-density map depicting the RBB and myocardial activation separately. (A) The local electrograms were annotated with the RBB activation. At the earliest site (origin), the RBB potential preceded the QRS onset by 42 ms (B) The local electrograms were annotated with the myocardial activation. At the earliest myocardial activation site (breakout site), the RBB potential was recorded immediately before the myocardial activation, suggesting the Purkinje-muscle junction. The red dot indicates the successful ablation site. RBB, right bundle branch; TV, tricuspid valve

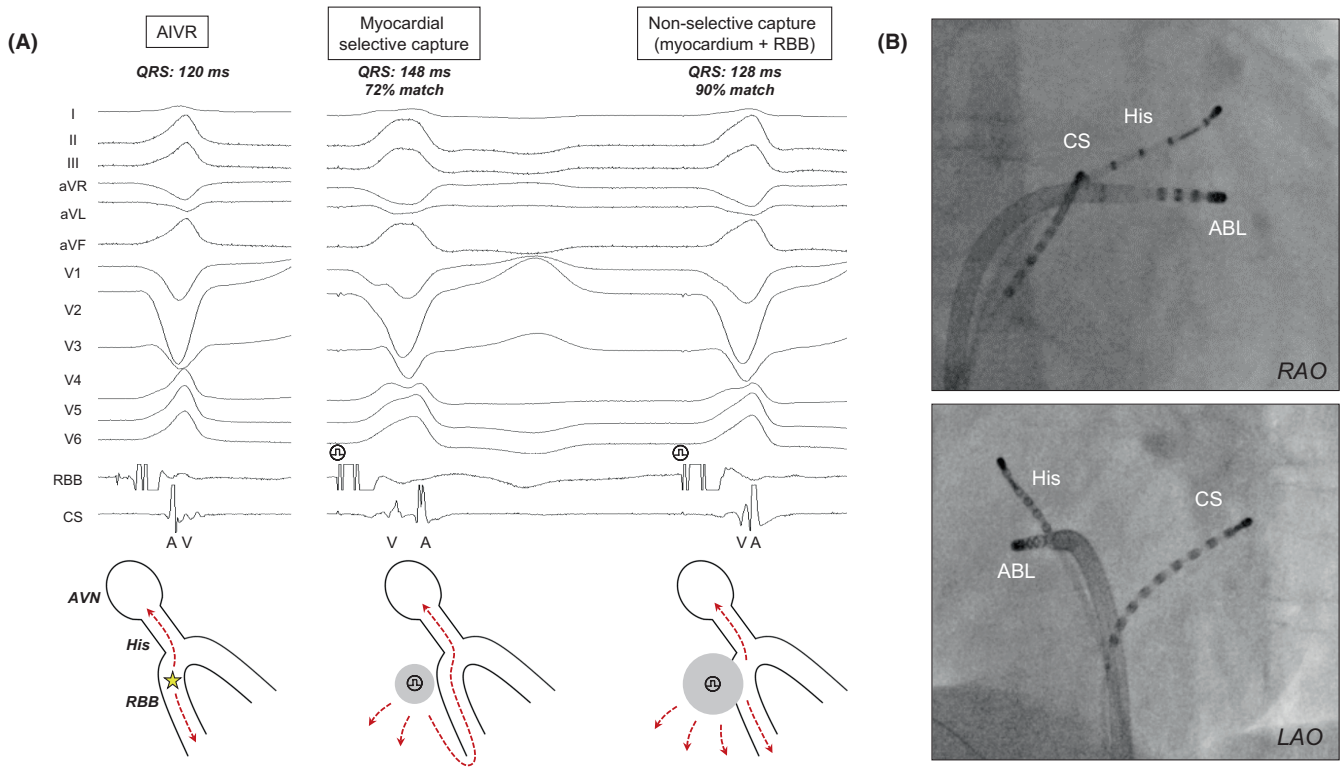

FIGURE 3 Pace mapping at the earliest RBB activation site. (A) Pace mapping from the earliest RBB activation site showed a change in the QRS complex depending on the pacing output. We could not capture the RBB selectively, and a perfect pace map of the AIVR was not recorded. (B) The successful ablation site. ABL, ablation catheter; AIVR, accelerated idioventricular rhythm; AVN, atrioventricular node; CS, coronary sinus; RBB, right bundle branch.

The second map was constructed with a reannotation of the local myocardial activation. This map also exhibited a focal activation pattern 16 mm from the earliest RBB activation site. At the earliest myocardial activation site (breakout site), the RBB potential was recorded immediately before the myocardial activation, suggesting the Purkinje-muscle junction (Figure 2B). The pathway from the earliest RBB activation site to the breakout site was considered as a preferential pathway, which was previously reported by Itoh et al.[1] During pace mapping at the earliest RBB activation site, the morphology of the QRS complex changed depending on the pacing output. When only the ventricular muscle was captured with a low output (4 V), the QRS interval was 148 ms. When the ventricular muscle and RBB were simultaneously captured (5 V), the ventricle and atrial potential were excited at the same time and the QRS width was 128 ms. We could not capture the RBB selectively, and a perfect pace map of the AIVR was not recorded (Figure 3A). This finding also suggested that the AIVR originated from the RBB. Considering the risk of His bundle block, radiofrequency ablation was first performed 6 mm distal to the earliest RBB activation site (Figure 3B). The AIVR terminated within 1.4 seconds after the radiofrequency delivery was started, and complete right bundle branch block was observed. After the single ablation application, no recurrence of the arrhythmia was observed for 30 min. He was discharged without any complications and no recurrence was observed for 1 year after the procedure.

2 | DISCUSSION

Accelerated idioventricular rhythm originating from the RBB was reported as a rare ventricular arrhythmia.[2,3] Itoh et al. reported that a preferential pathway is often observed from proximal origins to distal breakout sites during this type of arrhythmia.[1] To the best of our knowledge, this is the first report to show the activation of a preferential pathway with a high-density map during an RBB-AIVR. In this case, the myocardial activation map exhibited a single breakout site, and it suggested there was no branching of the Purkinje fibers from the preferential pathway. The length of the preferential pathway was 16 mm, and the conduction time was 28 ms. The conduction velocity of the preferential pathway was calculated as 0.57 m/s, which was slower than the normal conduction velocity of the Purkinje fibers.[4] That suggested that an impaired

Purkinje fiber could have caused the AIVR in this case. The successful ablation site was 6 mm from the earliest RBB activation site, and we probably blocked the preferential pathway conduction.

AUTHOR CONTRIBUTIONS

Takuro Nishimura: Formal analysis; writing – original draft. **Masahiko Goya:** Supervision; writing – review and editing. **Miho Negishi:** Writing – review and editing. **Takashi Ikenouchi:** Writing – review and editing. **Tasuku Yamamoto:** Writing – review and editing. **Kentaro Goto:** Writing – review and editing. **Takatoshi Shigeta:** Writing – review and editing. **Susumu Tao:** Writing – review and editing. **Masateru Takigawa:** Writing – review and editing. **Shinsuke Miyazaki:** Methodology. **Tetsuo Sasano:** Supervision; writing – review and editing.

CONFLICT OF INTEREST STATEMENT

The authors have no conflicts to disclose.

DATA AVAILABILITY STATEMENT

Data are available on request from the authors.

CONSENT

Written informed consent was obtained from the patient to publish this report in accordance with the journal's patient consent policy.

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