



Case Report

Late reversible complete atrioventricular block and PR interval normalization after antegrade slow pathway ablation for atrioventricular nodal re-entrant tachycardia with pre-existing PR prolongation



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ABSTRACT

Late complete atrioventricular block (CAVB) is a rare periprocedural complication in the treatment of atrioventricular (AV) nodal re-entrant tachycardia. However, it can necessitate permanent pacemaker implantation. We present a case of late CAVB that developed during the periprocedural period. Its pathogenesis was attributed to the indirect or functional effects on the fast pathway of the AV node due to the presence of paroxysmal supraventricular tachycardia with PR prolongation. Additionally, PR prolongation regressed to within the normal range after curing the late CAVB, and the advanced AV block with treadmill exercise stress test also improved 1:1 AV conduction with time. Periprocedural complications such as bradyarrhythmia may be reversible if late CAVB occurs within a few weeks after ablation. Thus, urgent permanent pacemaker implantation should be carefully considered.

Learning objective: Late high-grade atrioventricular (AV) blocks can develop during the periprocedural period even if antegrade slow pathway ablation does not result in a complete AV block. Late high-grade AV block is a relatively rare periprocedural complication. However, it can necessitate permanent pacemaker implantation. Additionally, if a late high-grade AV block develops within a few weeks after ablation, bradyarrhythmia—such as periprocedural complications—may be reversible and indicate that permanent pacemaker implantation should be carefully considered.

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Introduction

Antegrade slow pathway (SP) ablation with radiofrequency energy is the standard treatment for atrioventricular (AV) nodal re-entrant tachycardia (AVNRT). The success rate for treatment is high, and the risk of complications, including AV block, is <1% [1]. Late high-grade AV block is relatively rare but may necessitate permanent pacemaker implantation. Immediate AV conduction disturbances or high-grade AV block after radiofrequency delivery is attributed to direct injury to the fast pathway (FP). However, the pathogenesis of late high-grade AV block is not fully understood. Further, if the pre-existing PR interval prolongation improves to within the normal PR interval range after SP ablation due to AVNRT, it makes the explanation of the pathogenesis more difficult.

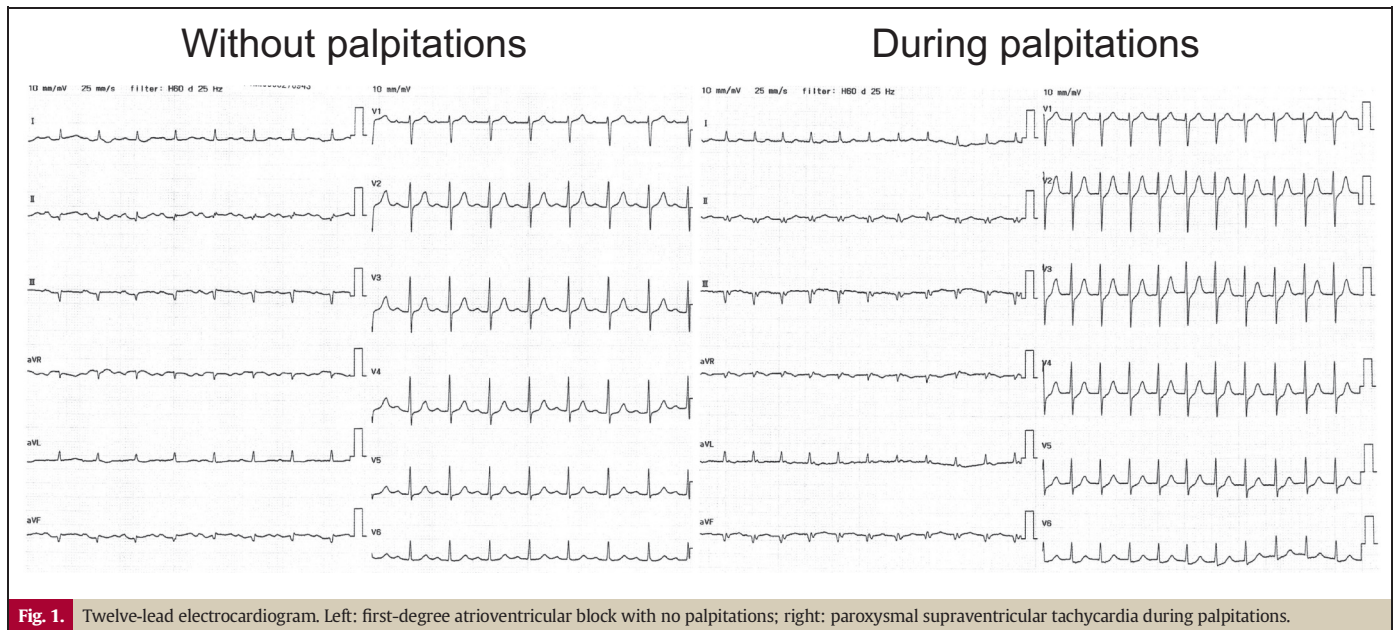
The definitive mechanism for the present case was not fully elucidated. However, we considered this case to be relatively rare. We thus report a case of typical AVNRT with first-degree AV block that developed into transient late complete atrioventricular block (CAVB) and improved to within the normal PR interval range one month after SP ablation.

Case report

The patient was an 80-year-old woman with symptomatic paroxysmal supraventricular tachycardia who had experienced palpitations for several years. An electrocardiogram revealed a first-degree AV block (PR interval: 218 ms; Fig. 1) during sinus rhythm, and her QRS complex tachycardia demonstrated a deeply inverted P wave in leads II, III, aV_L and aV_F just after the QRS complex during paroxysmal supraventricular tachycardia. Five years prior, she had undergone percutaneous coronary stenting of segment three of the right coronary artery for acute myocardial infarction with cardiogenic shock due to bradyarrhythmia.

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She was admitted to our hospital due to refractory paroxysmal supraventricular tachycardia and underwent catheter ablation. An electrophysiological study confirmed that the tachyarrhythmia was typical AVNRT. Atrio-His and His-ventricular intervals at the baseline were 118 ms and 53 ms, respectively. The antegrade effective refractory period of AV conduction was 340 ms, which was within the normal range. Dual AV nodal physiology was demonstrated with a sudden 350-ms increase in the atrio-His interval for a 10-ms decrement in coupling interval during extra-stimulus testing. After administering isoproterenol hydrochloride, typical AVNRT was observed.

We performed radiofrequency ablation of the antegrade SP via an anatomical approach, away from the recording site of the His bundle electrocardiograms. The electrophysiological approach was used to target the SP potential (Fig. 2A). We used a non-irrigated ablation catheter (Abbott Laboratories, Chicago, IL, USA) under the guidance of the Ensite Navx cardiac mapping system (Abbott Laboratories). We performed 110 ppm rapid pacing from the right atrium to confirm antegrade AV conduction, which was blocked by four beats at 2:1 AV conduction during ablation (Fig. 2A). Thus, we immediately stopped the ablation, and stable 1:1 AV conduction was maintained thereafter. The atrio-His and His-ventricular intervals after the third round of ablation (25–30 W) were 156 ms and 58 ms, respectively. The antegrade effective refractory period of AV conduction was 470 ms. Dual AV nodal physiology after ablation showed remaining jump and no echo, and AVNRT was not induced by extra-stimulus testing with or without isoproterenol hydrochloride. Electrocardiography monitoring indicated sinus rhythm with mild PR prolongation after the patient returned to the sickroom.

On the procedural day, several hours after ablation, the basic rhythm had worsened from first-degree AV block to high-grade with CAVB (Fig. 2B). On post-procedural day three, regression was noted, and significant first-degree AV block was regained after continuous isoproterenol hydrochloride infusion. Episodes of syncope with transient high-grade AV block were not observed on the electrocardiogram monitor recordings, even during CAVB with stable junctional escape rhythm. Although significant PR prolongation remained (Fig. 3A), the high-grade AV block did not recur without infusion of isoproterenol hydrochloride after 1:1 AV conduction recovery. We considered that the high-grade AV block with CAVB was induced by post-procedural effects. Thus, treadmill exercise stress tests were performed to confirm daily load tolerance. Advanced AV block was observed during the cardiac stress test (Fig. 3B), but AV conduction was stable on daily load. Thus, the patient was discharged.

One month post-discharge, the significant first-degree AV block had improved, and the PR interval was within the normal range (PR interval: 182 ms; Fig. 3A). Normal sinus rhythm was maintained with noted PR shortening (PR interval: 164 ms; Fig. 3A) over the three months of follow-up. During the 6-month follow-up, 1:1 AV conduction was maintained during cardiac stress testing (Fig. 3B), and the patient did not experience syncope or palpitations.

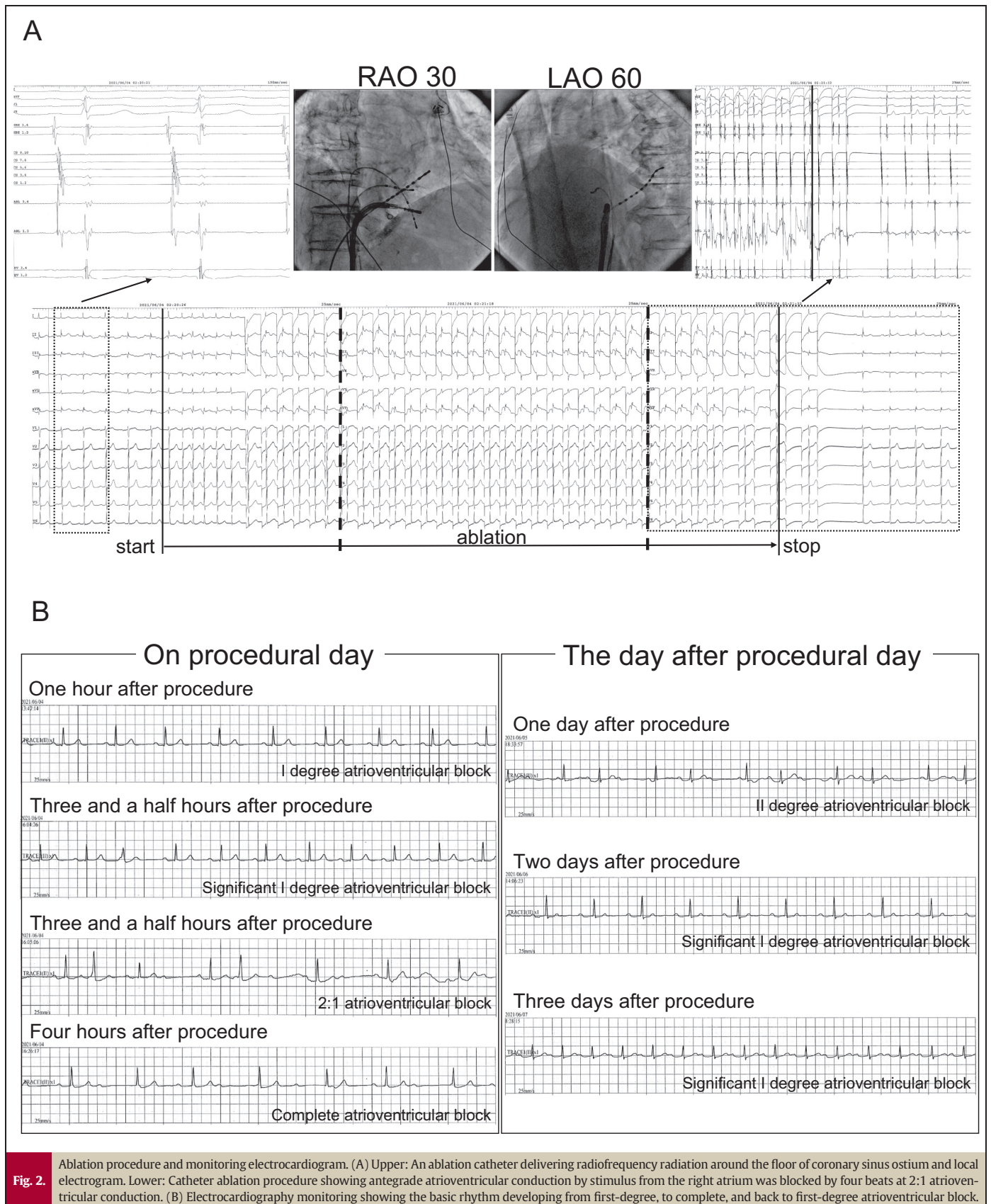
Discussion

Catheter ablation for AVNRT is a highly effective treatment with a success rate of >95% [1]. While overall complication rates are low, iatrogenic CAVB remains well-recognized as one of its major complications. Prior series have reported that 0.8–1.0% of cases result in CAVB requiring pacemaker implantation [1]. Although late CAVB is a relatively rare complication, the necessity of implanting a permanent pacemaker must be considered [2–5]. Moreover, the cause of late occurrence is not well known.

The patient in this case exhibited first-degree AV block and underwent antegrade SP ablation for typical AVNRT, thereby causing further PR prolongation. Prior studies have reported that antegrade SP ablation did not affect PR interval in patients with AVNRT and first-degree AV block [6,7]. However, one patient with first-degree AV block was reported to present with further PR prolongation after a procedure. The PR interval did not improve, and the results were not discussed [6]. Nonetheless, late AV block may occur in patients with pre-existing prolonged PR intervals compared with normal PR intervals [7].

A previous report suggested that the predictive factor for late high-grade AV block was transient CAVB during radiofrequency ablation [8]. In the present case, CAVB did not occur during the ablation procedure, neither did fast ventriculoatrial conduction during junctional ectopy. Thus, the possibility of direct injury to the AV node was considered low. The underlying mechanisms of the late high-grade AV block after antegrade SP ablation are unclear. However, they may be attributable to the ongoing healing process of radiofrequency lesions, such as local edema, inflammation, and microvascular endothelial cell injury [2,3]. As CAVB was reversible in this case, indirect injury to the AV node may have had an effect.

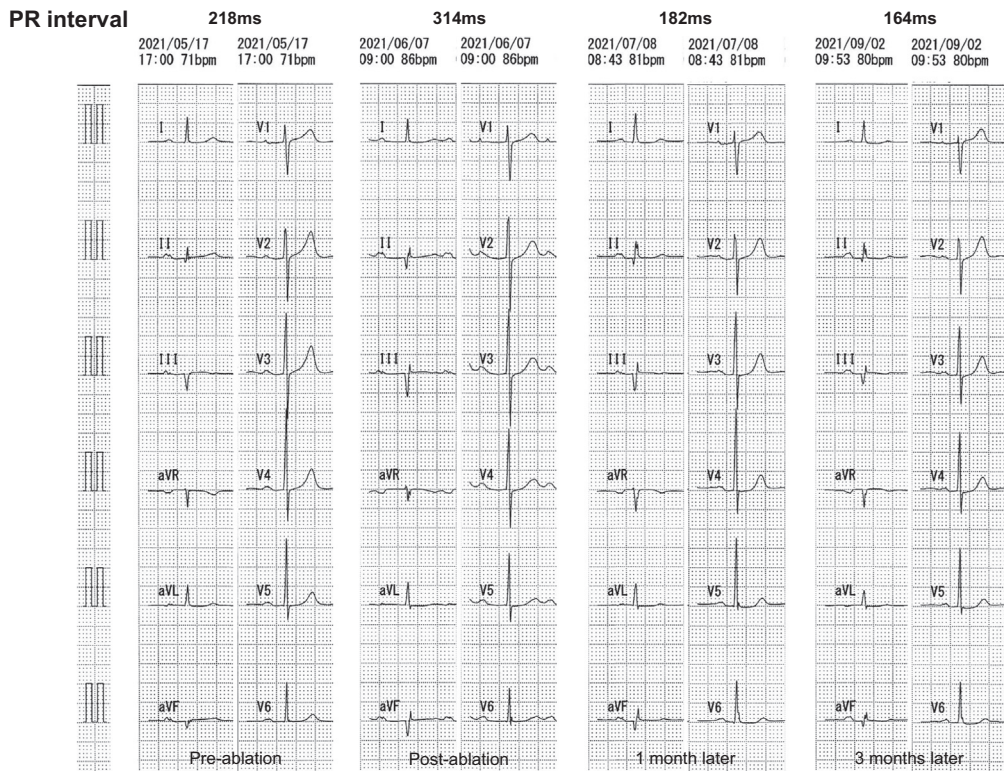
It has been reported that SP ablation at the bottom of Koch's triangle induced local parasympathetic denervation and attenuated local autonomic signaling in the AV node [9]. Therefore, although



the activity of the autonomic nervous system was unclear, it may have contributed to AV conduction with PR interval normalization in the chronic phase.

Cheniti et al. [10] suggested that, despite impairment, the FP of the AV node may be partially functional due to electrical interactions and concealed conduction in standard AVNRT ablation. Additionally, they

A



B

Atrioventricular nodal function on treadmill

Before discharge

At 6-month follow-up

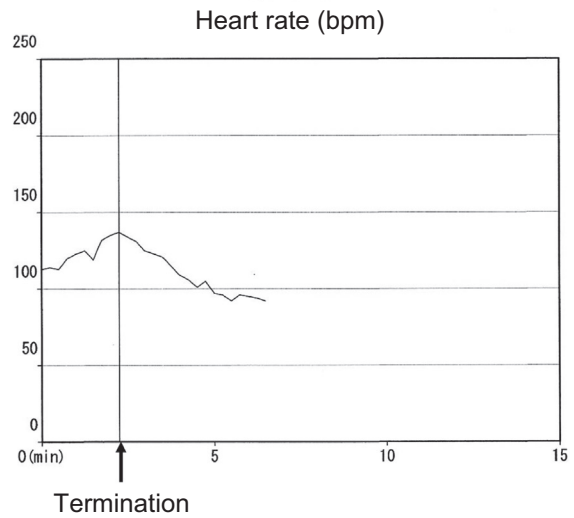
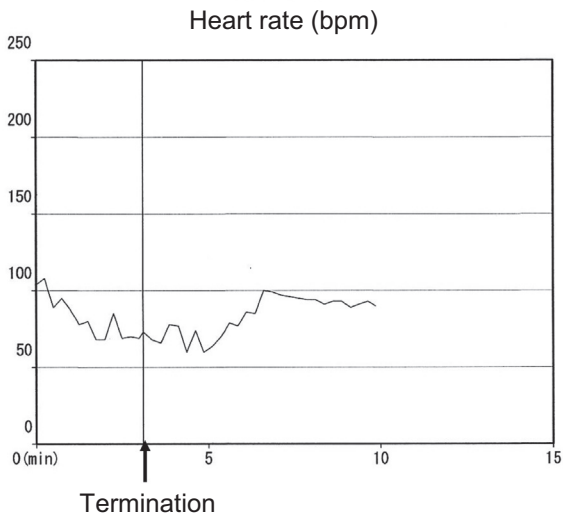


Fig. 3. Changes in twelve-lead electrocardiogram and treadmill test results. (A) Twelve-lead electrocardiogram showing transition from significant PR interval prolongation to shortening of PR interval to within the normal range and 1:1 atrioventricular conduction. (B) Atrioventricular nodal function on a treadmill showing impaired 1:1 atrioventricular conduction before discharge and improved 1:1 atrioventricular conduction 3 months later.

reported that functional FP inhibition would improve after SP ablation with subsequent PR interval shortening. Thus, antegrade SP ablation may have caused similar phenomena in addition to the mechanisms described earlier.

In previous reports, bradyarrhythmia did not require permanent pacemaker implantation when the high-grade AV block developed 1–2 weeks after, as opposed to during, the procedure [2,3]. Other reports have shown that high-grade AV block with no CAVB during ablation after the periprocedural period almost required permanent pacemaker implantation [4,5]. In summary, a high-grade AV block that developed within 1–2 weeks is distinct from one that developed after the periprocedural period. In the present case, the CAVB was reversible and did not require permanent pacemaker implantation. PR interval prolongation regressed, and the PR interval fell within the normal range one month later. Furthermore, the resolution and PR interval prolongation was maintained, and improvement of AV nodal function was confirmed with time. Therefore, we believe that the AV block was due to indirect or functional effects.

In the present case, preferential SP conduction may have presented with preserved FP antegrade conduction. Transient CAVB and further PR interval prolongation likely resulted from antegrade SP ablation with indirect or functional FP inhibition rather than direct FP injury. Removing FP inhibition resulted in the resolution of PR interval prolongation, maintenance of normal sinus rhythm, and improvement of AV nodal function. There was no recurrence of palpitations, and syncope secondary to high-grade AV block was not observed throughout the follow-up period. Therefore, permanent pacemaker implantation was not necessitated. Nonetheless, due to the continuous healing process of the radiofrequency lesions, fibrosis may occur over weeks to months [2,5], and we cannot predict the recurrence of very late high-grade AV block. Thus, close follow-up and monitoring should be continued.

Conclusion

We report a case of reversible CAVB that occurred only a few days after antegrade SP ablation, without CAVB during the procedure. Although the exact mechanism is unclear, we hypothesized that this AV block developed during the periprocedural period due to the indirect or functional effects on the FP of the AV node. If a high-grade AV block occurs within a few weeks, periprocedural complications such as bradyarrhythmia are likely reversible, and symptomatic high-grade AV block would be less likely to recur. Urgent permanent pacemaker implantation may be avoided in these situations under continuous careful follow-up.

Declaration of competing interest

The authors declare that there is no conflict of interest.

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