Received: 8 September 2022 | Revised: 22 November 2022 | Accepted: 11 December 2022

DOI: 10.1002/ccr3.6791

CASE REPORT

Clinical Case Reports Open Access WILEY

A case of successful catheter ablation of blocked atrial bigeminy and bradycardia with the recovery of normal sinus rhythm and myocardial reverse remodeling

Tomomi Sugiyama[1,2,3] | **Yoshiaki Mizutani**[1] | **Satoshi Yanagisawa**[2] | **Masaaki Kanashiro**[1] | **Yasuya Inden**[2] | **Toyoaki Murohara**[2]

[1]Department of Cardiology, Yokkaichi Municipal Hospital, Yokkaichi, Japan

[2]Department of Cardiology, Nagoya University Graduate School of Medicine, Nagoya, Japan

[3]Department of Cardiology, Kainan Hospital, Yatomi, Japan

Correspondence
Yoshiaki Mizutani, Department of Cardiology, Yokkaichi Municipal Hospital, 2-2-37, Shibata, Yokkaichi, Mie, Japan.
Email: yoshiaki522000@yahoo.co.jp

Abstract

A 69-year-old man presented bradycardia with a constant blocked atrial bigeminy and heart failure. Successful catheter ablation of blocked atrial bigeminy with bradycardia resulted in myocardial reverse remodeling and restoration of the normal sinus rhythm from the ectopic atrial rhythm.

KEYWORDS

ablation, blocked atrial bigeminy, bradycardia, ectopic atrial rhythm, myocardial reverse remodeling, premature atrial contraction

1 | INTRODUCTION

Bradycardia is a commonly observed arrhythmia, and management of symptomatic bradycardia is crucial. The major causes of bradycardia are organic heart disease, inherited diseases, aging, and drug-induced bradycardia. However, atrial bigeminy with blocked premature atrial contraction (PAC) can lead to bradycardia. Blocked atrial bigeminy occurs even in the absence of underlying structural heart disease, and the treatment for bradycardia with blocked atrial bigeminy is slightly different compared to that for typical symptomatic bradycardia.[1,2] Similar to abnormal persistent tachyarrhythmia, severe bradycardia can also induce cardiomyopathy and heart failure.[3,4] However, there are few reports of myocardial remodeling and cardiomyopathy due to bradycardia with blocked atrial bigeminy.[5,6]

Herein, we studied a case of bradycardia with blocked atrial bigeminy and ectopic atrial rhythm, resulting in cardiac remodeling and heart failure. Successful catheter ablation of blocked PACs resulted in recovery to normal sinus rhythm with myocardial reverse remodeling.

2 | CASE REPORT

A 69-year-old man who visited the emergency department of Yokkaichi Municipal Hospital presented with fatigue and dizziness. This patient had a history of hypertension treated by administration of telmisartan 20 mg/day. A surface 12-lead electrocardiogram (ECG) showed sinus bradycardia with a heart rate of 36 beats/minute (bpm) and a constant blocked atrial bigeminy (Figure 1). The based rhythm represented sinus rhythm intermittently at the initial examination but was disappeared with the emergence of an ectopic atrial rhythm thereafter. No medication for the risk of bradycardia was administered. Transthoracic echocardiography revealed mild reduced cardiac function

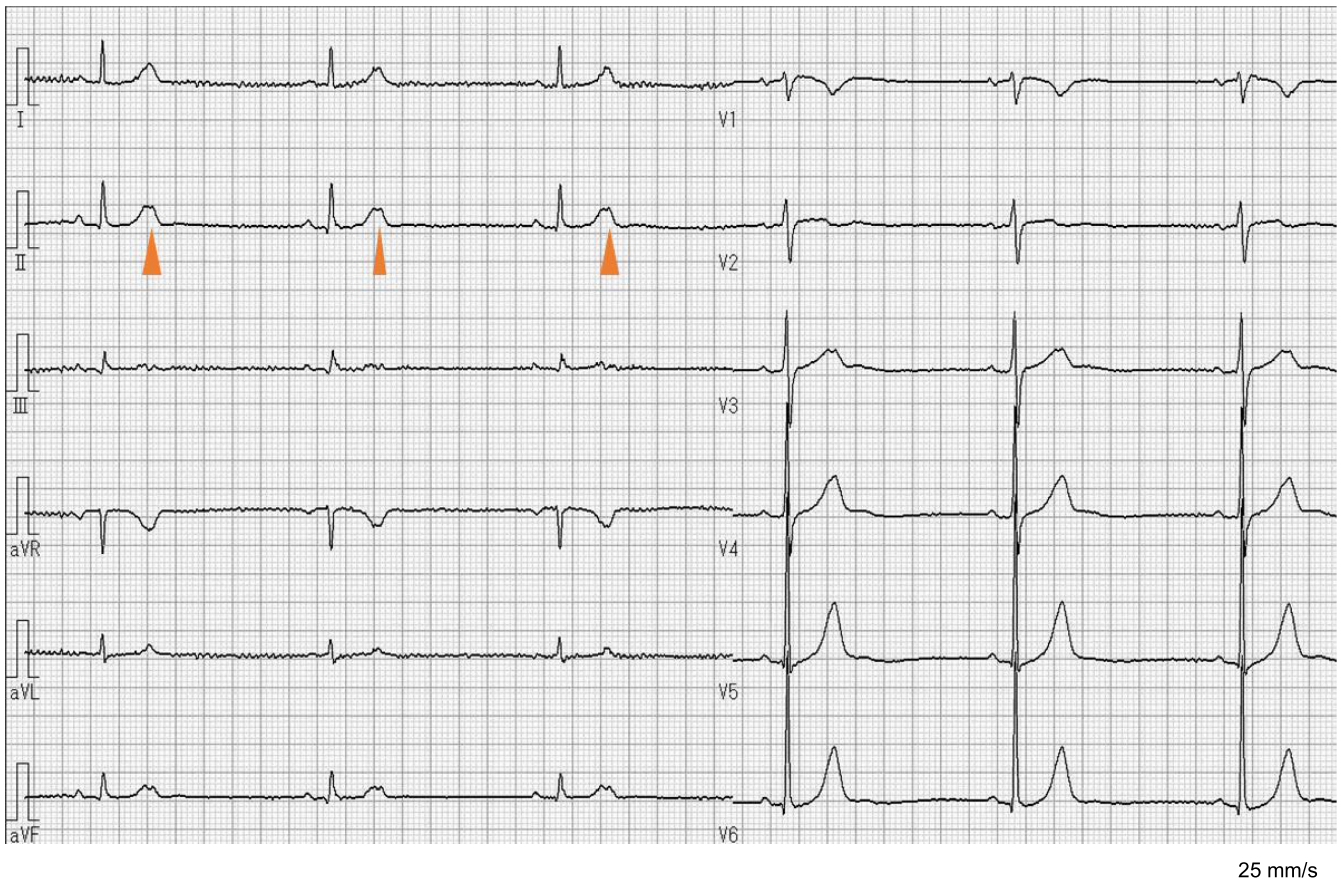

FIGURE 1 A standard 12-lead electrocardiogram before ablation. Orange arrows indicate premature atrial contraction (PAC) behind the T-wave of the sinus rhythm.

with left ventricle ejection fraction (LVEF) of 50%, a mild to moderate degree of tricuspid regurgitation (TR), and mild enlargement of the right atrium of 4.0 × 5.5 cm in a 4-chamber view. The patient had shortness of breath when walking upstairs (New York Heart Association [NYHA] functional class II). Blood sample examination showed high brain natriuretic peptide (BNP) levels of 220 pg/ml. Other electrolytes and fluid balance (e.g., sodium and potassium) were within normal limits. The patient had no family history of sudden death or genetic disorders. To treat the symptomatic bradycardia, we planned an electrophysiology study (EPS) and a catheter ablation of blocked atrial bigeminy after obtaining informed consent from the patient and his family.

The EPS was performed as the standard procedure using three electrode catheters, namely a decapolar catheter in the coronary sinus, a quadripolar catheter in the His-bundle region, and a mapping catheter positioned in the right ventricle. The right atrium (RA) was mapped using a multipolar electrode catheter (PentaRay NAV High-Density Mapping catheter; Biosense Webster, Inc.) and a three-dimensional mapping system (CARTO® 3 system; Biosense Webster, Inc.) to identify the origin of the PACs. During the EPS, an ECG showed intermittent blocked premature atrial contractions with an ectopic atrial rhythm. The intracardiac electrogram showed an atrial-His block in the blocked PAC (Figure 2A). The basic rhythm was an ectopic atrial rhythm originating from the posterior site of the RA during procedure. A bipolar voltage map showed extensive low-voltage areas in the upper, lower, and anterior portions of the RA (Figure 2B). The basic rhythm was an ectopic atrial rhythm originating from the posterior site of the RA (Figure 2C). During the mapping procedure, the target PAC unfortunately disappeared because of the mechanical bump of the mapping catheter. Therefore, we performed the ablation around the bumped area, which was located 16 mm from the site of ectopic atrial rhythm. Subsequent ablation of the possible site of PAC origin was performed using an open-irrigated ablation catheter (THERMOCOOL SMARTTOUCH® SF Catheter; Biosense Webster, Inc.) (Figure 2C). The PAC did not appear again after a sufficient waiting period and isoproterenol loading. The procedure was completed under an ectopic atrial rhythm with a heart rate of 50 bpm, and sinus node rhythm was not observed even after isoproterenol loading. The patient's symptoms disappeared and he was discharged the day after the procedure without complications.

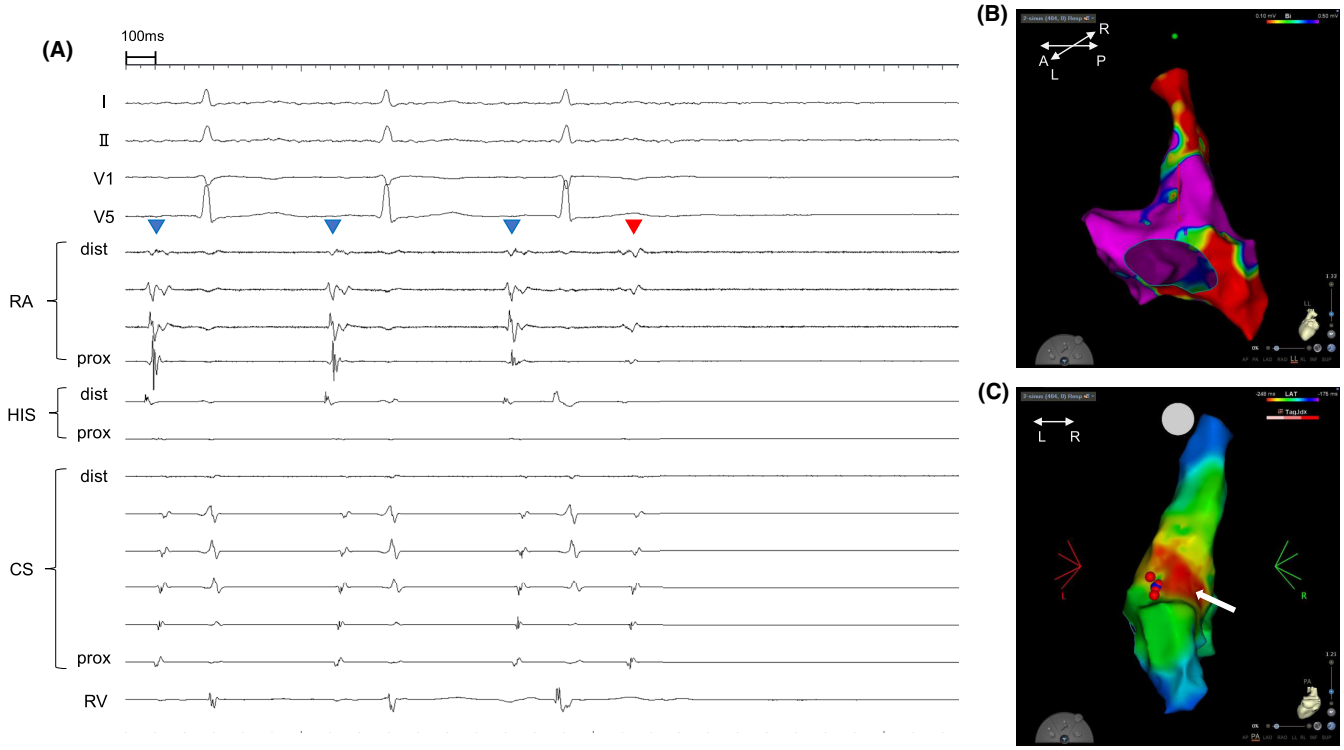

FIGURE 2 (A) The intracardiac electrogram during the EPS. Blue triangle shows ectopic atrial rhythm. Red triangle shows blocked premature atrial contraction. (B) The bipolar voltage mapping in the left lateral view. Extensive low-voltage area in the right atrium. Purple color represents electrogram voltage >0.5 mV, and red color indicates electrogram voltage <0.1 mV. (C) The propagation map of the ectopic atrial rhythm in the posterior anterior view. White arrow indicates an origin of the ectopic rhythm. The blue tag was the suspected origin of the PAC at the septum of the right atrium. Red tags represent ablation points.

2.1 | Follow-up and repeat electrophysiology study

The patient was followed up at the outpatient clinic 1 and 3 months after the procedure. At each visit, the patient underwent ECG and 24-h Holter monitoring to assess the recurrence of PAC and bradycardia (Figure 3A). The 24-h Holter monitoring after 3 months showed a relatively low number of total heartbeats of 80,983 beats and PACs of 88 beats/day without blocked PACs. Considering the possibility of progression of the unknown structural cardiomyopathy and evaluation of conduction disturbance, EPS was scheduled again after obtaining informed consent from the patient. The procedure was performed using the same system as in the initial session. The bipolar voltage and propagation maps in the RA were acquired during the intrinsic rhythm using a multipolar electrode catheter. The low-voltage area in the RA was significantly decreased compared to that in the initial session (Figure 3B). In addition, the intrinsic rhythm site shifted from the posterior wall of the RA to the high lateral RA, where the normal sinus node is typically located in the propagation mapping (Figure 3C). The sinus node recovery time was 1424 ms, which was within the normal range. The conduction velocity in the right atrium was improved from 0.81 m/sec at the first session to 0.96 m/sec at the second session after the elimination of PACs. Furthermore, there was no atrioventricular conduction disturbance, with an atrial-His Wenckebach rate of 150 bpm. Three months after the ablation, the BNP levels improved from 220 to 53.6 pg/ml. The NYHA class improved from II to I. Echocardiography demonstrated that the LVEF improved from 50% to 64%, and the size of the right atrium reduced from 4.0 × 5.5 to 3.4 × 4.2 cm thereafter. Furthermore, the TR severity improved from mild/moderate to trivial three months after procedure. After five months of the procedure, the Holter ECG showed a PAC of 109 beats/day and a further improvement in the total number of the heartbeats of 97,473 beats without blocked PACs. Successful ablation therapy resulted in a stable course, with electrical and anatomical reverse remodeling and recovery of the sinus node function.

3 | DISCUSSION

We reported a rare case of blocked atrial bigeminy with an ectopic atrial rhythm causing unusual bradycardia and myocardial remodeling, which recovered after successful catheter ablation. This report has several important implications.

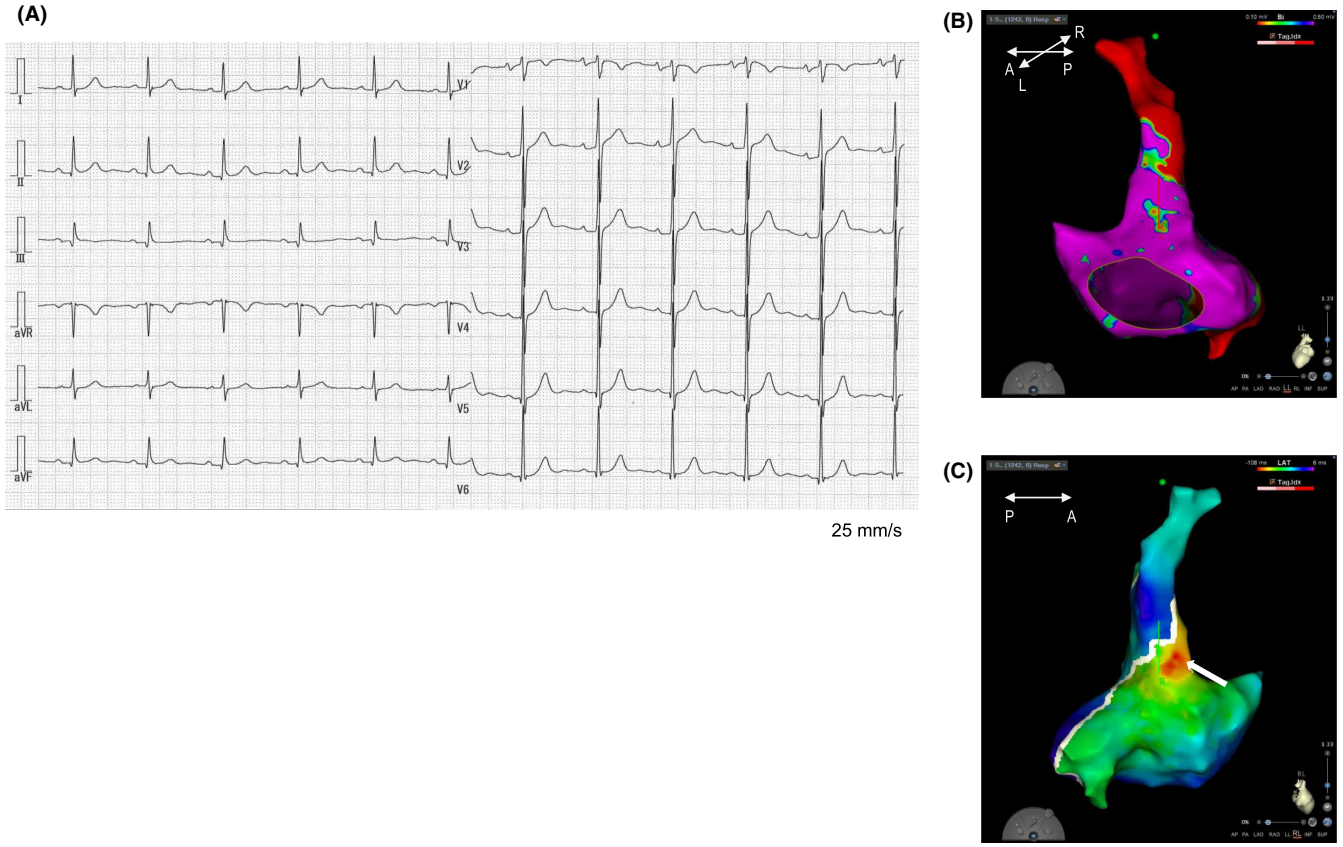

FIGURE 3 Examinations at three months after ablation. (A) Normal sinus rhythm. Normal sinus rhythm on the surface 12-lead electrocardiogram. (B) Bipolar voltage mapping in the left lateral view. Bipolar voltage mapping at repeat electrophysiology study shows decreased low-voltage area and electrical myocardial reverse remodeling in the right atrium. Purple color represents electrogram voltage >0.5 mV, and red color indicates electrogram voltage <0.1 mV. (C) Propagation map of intrinsic rhythm in the right left view. White arrow indicates earliest activated area indicating sinus node.

First, our case is unique because bradycardia caused by blocked atrial bigeminy resulted in myocardial remodeling. Although we did not perform additional examinations to evaluate the cause of cardiomyopathy in a cardiac magnetic resonance imaging study or biopsy examination, normalization of the low-voltage area in the RA, and improvement of the BNP levels and symptoms after the successful ablation could support the possible cause of bradycardia with blocked atrial bigeminy for the remodeling in this case. Furthermore, in conjunction with myocardial reverse remodeling following successful ablation for PAC and administration of angiotensin II receptor blocker, the basic intrinsic rhythm might shift from an ectopic atrial rhythm to a normal sinus rhythm. Frequent PACs with a short coupling interval probably inhibited the activity of the sinus node and induced the subsequent ectopic atrial rhythm. After the elimination of the PACs through successful ablation, sinus rhythm could emerge without any obstruction rhythm.

Second, catheter ablation of PAC could be an optimal treatment for bradycardia caused by blocked atrial bigeminy. Although most PACs are benign without the need for any specific treatment,[2] symptomatic bradycardia due to blocked atrial bigeminy requires some kind of treatment, as in this case. Medication therapy, such as beta-blockers or calcium channel blockers, could further exacerbate bradycardia and suppress sinus node function. Pacemaker implantation is generally not recommended as the initial option in this type of bradycardia,[7] and catheter ablation for diminishing the PAC would be the first choice with efficacy and safety. In this regard, Alper et al.[8] previously reported that catheter ablation of blocked PACs was effective in avoiding pacemaker implantation. Our report additionally strengthens the benefit of the abolishment of PACs through ablation regarding the electrical recovery of the myocardial remodeling, as shown in the repeated assessment of the EPS. It is surprising to observe the electrical reverse remodeling of the reduction of the low-voltage area after ablation, but the result would be interpreted cautiously requiring further investigations because the number of the points obtained around the low-voltage area was relatively low in the mapping images. Furthermore, frequent PACs have been reported to predominantly increase the risk of cardiovascular disease, especially atrial fibrillation,[9,10] and ablation of PAC could have prevented

the future development of atrial fibrillation. However, it is necessary to keep in mind that an alternative strategy and approach must be considered in cases with bradycardia and blocked atrial bigeminy originating from sensitive regions, such as the sinus node and around the atrioventricular node, which are unlikely to be treated by ablation, or those with the failure of the ablation procedure.

4 | CONCLUSIONS

We reported a case of blocked atrial bigeminy with an ectopic atrial rhythm causing unusual bradycardia and heart failure. Successful catheter ablation of blocked atrial bigeminy with bradycardia resulted in myocardial reverse remodeling and restoration of the normal sinus rhythm from the ectopic atrial rhythm. Catheter ablation is an effective treatment for blocked PACs and bradycardia.

AUTHOR CONTRIBUTIONS

Tomomi Sugiyama: Visualization; writing – original draft. **Yoshiaki Mizutani:** Conceptualization; project administration; writing – review and editing. **Satoshi Yanagisawa:** Investigation; writing – review and editing. **Masaaki Kanashiro:** Supervision; writing – review and editing. **Yasuya Inden:** Supervision; writing – review and editing. **Toyoaki Murohara:** Supervision; writing – review and editing.

ACKNOWLEDGMENTS

None.

FUNDING INFORMATION

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

DATA AVAILABILITY STATEMENT

Data sharing not applicable to this article as no datasets were generated or analysed during the current study.

CONSENT

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

ORCID

Yoshiaki Mizutani https://orcid.org/0000-0003-2373-7059

Satoshi Yanagisawa https://orcid.org/0000-0002-0658-5498

REFERENCES

1. Kusumoto FM, Schoenfeld MH, Barrett C, et al. 2018 ACC/AHA/HRS guideline on the evaluation and Management of Patients with Bradycardia and Cardiac Conduction Delay: executive summary: a report of the American College of Cardiology/American Heart Association task force on clinical practice guidelines, and the Heart Rhythm Society. *J Am Coll Cardiol*. 2019;74(7):932-987. doi:10.1016/j.jacc.2018.10.043
2. Wren C. Cardiac arrhythmias in the fetus and newborn. *Semin Fetal Neonatal Med*. 2006;11(3):182-190. doi:10.1016/j.siny.2005.12.001
3. Kafalı HC, Öztürk E, Özgür S, Tunca Şahin G, Güzeltaş A, Ergül Y. Electrophysiologic characteristics and catheter ablation results of tachycardia-induced cardiomyopathy in children with structurally normal heart. *Anatol J Cardiol*. 2020;24(6):370-376. doi:10.14744/AnatolJCardiol.2020.99165
4. Omichi C, Tanaka T, Kakizawa Y, et al. Improvement of cardiac function and neurological remodeling in a patient with tachycardia-induced cardiomyopathy after catheter ablation. *J Cardiol*. 2009;54(1):134-138. doi:10.1016/j.jjcc.2008.10.002
5. Gross GJ. Bradycardia-mediated ventricular electrical remodeling. *J Cardiovasc Electrophysiol*. 2006;17(Suppl 1):S178-s182. doi:10.1111/j.1540-8167.2006.00400.x
6. Ip JE, Lerman BB. Deceptive nature of atrial premature contractions: ablating 2 arrhythmias with 1 burn. *Circulation*. 2014;130(17):e148-e150. doi:10.1161/circulationaha.114.011155
7. Mulpuru SK, Madhavan M, McLeod CJ, Cha YM, Friedman PA. Cardiac pacemakers: function, troubleshooting, and management: part 1 of a 2-part series. *J Am Coll Cardiol*. 2017;69(2):189-210. doi:10.1016/j.jacc.2016.10.061
8. Alper A, Gungor B, Turkkan C, Tekkesin A. Symptomatic bradycardia caused by premature atrial contractions originating from right atrial appendage. *Indian Pacing Electrophysiol J*. 2013;13(3):114-117. doi:10.1016/s0972-6292(16)30628-3
9. Durmaz E, Ikitimur B, Kilickiran Avci B, et al. The clinical significance of premature atrial contractions: how frequent should they become predictive of new-onset atrial fibrillation. *Ann Noninvasive Electrocardiol*. 2020;25(3):e12718. doi:10.1111/anec.12718
10. John AG, Hirsch GA, Stoddard MF. Frequent premature atrial contractions impair left atrial contractile function and promote adverse left atrial remodeling. *Echocardiography (Mount Kisco, NY)*. 2018;35(9):1310-1317. doi:10.1111/echo.14026

How to cite this article: Sugiyama T, Mizutani Y, Yanagisawa S, Kanashiro M, Inden Y, Murohara T. A case of successful catheter ablation of blocked atrial bigeminy and bradycardia with the recovery of normal sinus rhythm and myocardial reverse remodeling. *Clin Case Rep*. 2022;10:e06791. doi:10.1002/ccr3.6791