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ELECTROPHYSIOLOGY

CASE REPORT: CLINICAL CASE

Bailout Deep Septal LV Pacing to Treat Inadvertent Complete AV Block During Complex Ablation Procedure

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ABSTRACT

We present a case of persistent complete atrioventricular block that occurred during the diagnostic portion of a premature ventricular contractions' radiofrequency ablation in a complex heart failure patient. The case was managed by bailout deep left ventricular septal pacing after bipolar radiofrequency elimination of premature ventricular contractions. (J Am Coll Cardiol Case Rep 2024;29:102227) Crown Copyright © 2024 Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 78-year-old man was admitted with the signs of advanced heart failure (HF), shortness of breath with minimal physical exertion, swollen ankles, and general weakness accompanied by irregular heart rhythm.

LEARNING OBJECTIVES

- To recognize persistent complete AV block as an extremely rare but possible complication during the diagnostic portion of an electrophysiological procedure.
- To advocate deep LV septal–LBB pacing by 1 lead and single-chamber pacemaker implantation as a viable alternative to classical CRT in the complex HF patient with permanent AF, who suddenly developed severe bradycardia during catheter ablation of PVCs.
- To demonstrate that bipolar RFA can increase successful elimination of PVCs in specific locations.

MEDICAL HISTORY

He had arterial hypertension for 30 years, permanent atrial fibrillation (AF) since 2014, and HF diagnosis since 2020.

DIFFERENTIAL DIAGNOSIS

The differential diagnoses included ischemic vs nonischemic cardiomyopathy.

INVESTIGATIONS

The patient had NYHA functional class III with 6-minute walking test of 280 m; left ventricular ejection fraction of 37%; electrocardiogram-AF, left

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ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

AV = atrioventricular

CRT = cardiac resynchronization therapy

HF = heart failure

LBB = left bundle branch

LV = left ventricular

PVC = premature ventricular contractions

RFA = radiofrequency ablation

RVOT = right ventricular outflow tract

bundle branch (LBB) block, QRS interval of 190 ms, frequent premature ventricular contractions (PVCs) with inferior axis (Figure 1); Holter electrocardiogram-permanent AF with a mean rate of 86 beats/min, and 15,600 high-grade PVCs (III-IV by Lown). Coronary angiography showed no significant stenosis of coronary arteries.

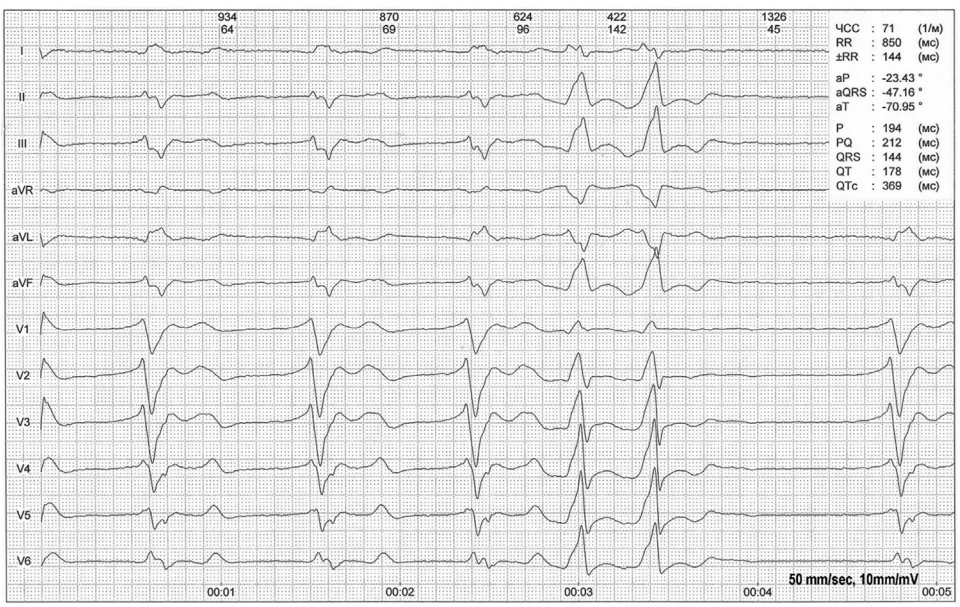
MANAGEMENT

The patient was prescribed valsartan 160 mg, torsemide 10 mg, eplerenone 50 mg, bisoprolol 5 mg, rivaroxaban 20 mg, and rosuvastatin 10 mg. Antiarrhythmic therapy (amiodarone 200 mg/d) was ineffective in controlling PVCs. The patient was offered staged treatment including: 1) radiofrequency ablation (RFA) of PVCs; 2) cardiac resynchronization therapy (CRT) implantation; and 3) atrioventricular block (AV) node ablation for the rate control.

During right ventricular outflow tract (RVOT) mapping, a complete AV block with escape rhythm <30 beats/min suddenly occurred, which was managed throughout the procedure by temporary right ventricular pacing (Figure 2).

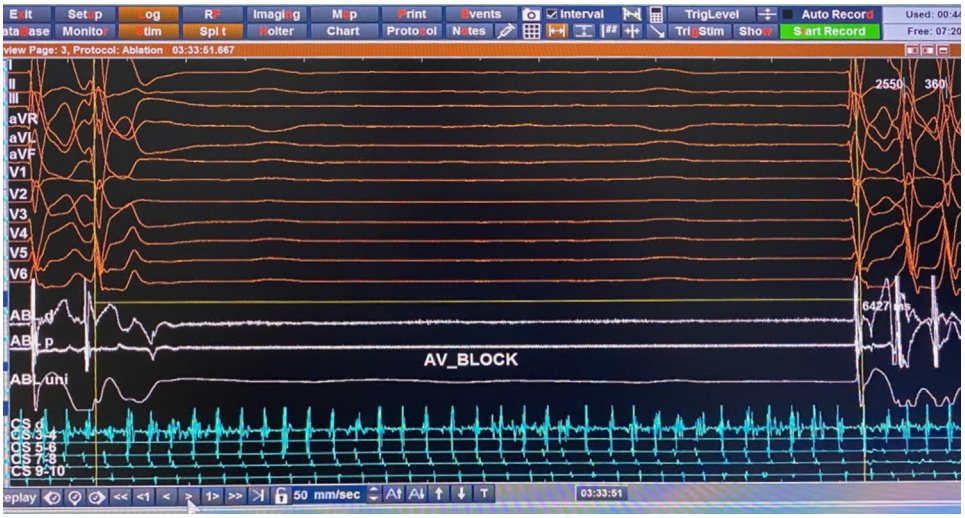
Further mapping in the RVOT and retrogradely in the aortic cusp was done. A wide area of early activation was defined in anteroseptal RVOT. At a site with signal prematurity of -30 ms to QRS interval, several radiofrequency lesions (40 W, 40 seconds, Ampere, Abbott; 13 mL/min flow, Cool Point, Abbott) were delivered with temporary suppression of PVCs during RFA. Then left ventricular outflow tract and aortic cusps were mapped and the earliest intracardiac signal (-58 ms) was seen in the left coronary cusp. Cool tip RFA in this area (30-35 W, up to 60 s) temporarily eliminated the PVCs, but arrhythmia recurred in 1-2 min. Because the PVCs origin was considered to be intramural, the decision to apply bipolar ablation was made. The ablation catheter (FlexAbility, Abbott - active) was placed at the earliest site of activation in the left coronary cusp. An additional ablation catheter (Therapy cool, Abbott - passive) was placed in RVOT closely opposite to the first one. Intracardiac echocardiography guidance was additionally used to control positioning, tissue contact, and ablation effect. Several bipolar RFAs eliminated PVCs, however, after 25 min less frequent PVCs with slightly different morphology relapsed. Additional mapping revealed the earliest (-35 ms) signal in the right coronary cusp and bipolar ablation with the

FIGURE 1 Initial ECG



Initial ECG presented AF, irregular heart rate of 45-96 beats/min, atypical LBB block with notched QRS interval of 175 ms with superior axis, and double PVCs had inferior axis. The second PVC has a coupling interval of 422 ms and "R on T" morphology. PVCs' pseudodelta wave in the inferior and left chest ECG leads along with slightly changing morphology indicate the deep site of origin and different exit points. AF = atrial fibrillation; ECG = electrocardiogram; LBB = left bundle branch; PVC = premature ventricular contraction.

FIGURE 2 **Inadvertent Complete AV Block Occurrence**



During RV outflow tract mapping, inadvertent complete AV block with escape rhythm <30 beats/min suddenly occurred; AV block presented after initial RV irritation by the pause of 6.4 s and was interrupted by mechanically provoked ectopy to avoid prolonged asystole till pacing from the ablation catheter was started. Coronary sinus catheter channels showed continuous AF electrogram. Consequently, pacing was switched to diagnostic quadripolar catheter placed in the RV apex. The rest of the procedure was done under temporary pacing. Temporary pacing was stopped after final placement of the permanent pacing lead and pacemaker implantation. AV = atrioventricular; RV = right ventricular; other abbreviations as in Figure 1.

same parameters and setup was made between right coronary cusp and a more proximal RVOT region under the pulmonic valve (Figure 3).

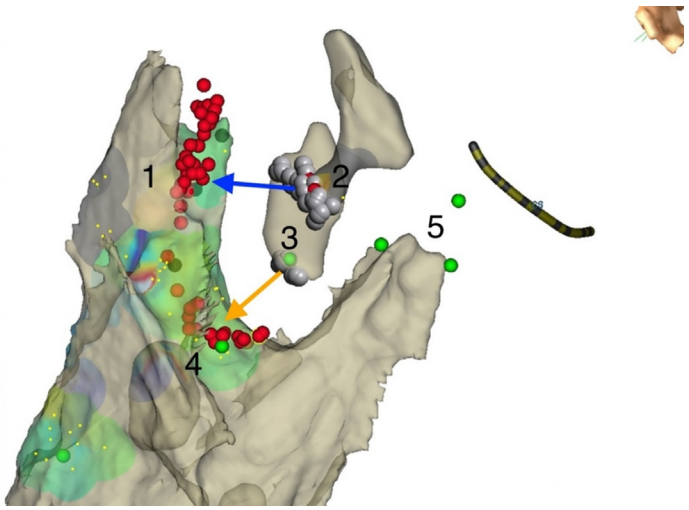
Because the distal AV block was persisting, pacemaker implantation was considered. The decision to adopt VVIR mode by deep left ventricular (LV) septal-LBB pacing was made. Fixed-screw active lead (Fineline II, Boston Scientific) through the delivery system (Selectra III, Biotronik) was successfully placed deep intramurally. Appropriate position was confirmed using angiography, changing of impedance, and pacing QRS morphology, and this was assisted using intracardiac echocardiography views (Figure 4).

Deep LV septal pacing in unipolar mode (threshold: 0.4 V; R waves: -7 to -9 mV; impedance: 620 ohms) was associated with significant shortening of QRS duration, incomplete right bundle branch block, and signs of LBB conduction system involvement such as 65 ms LV activation time and 10 ms isoelectric period between the pacing spike and QRS onset along with QRS morphology and duration of 120 ms (Figure 5).

DISCUSSION

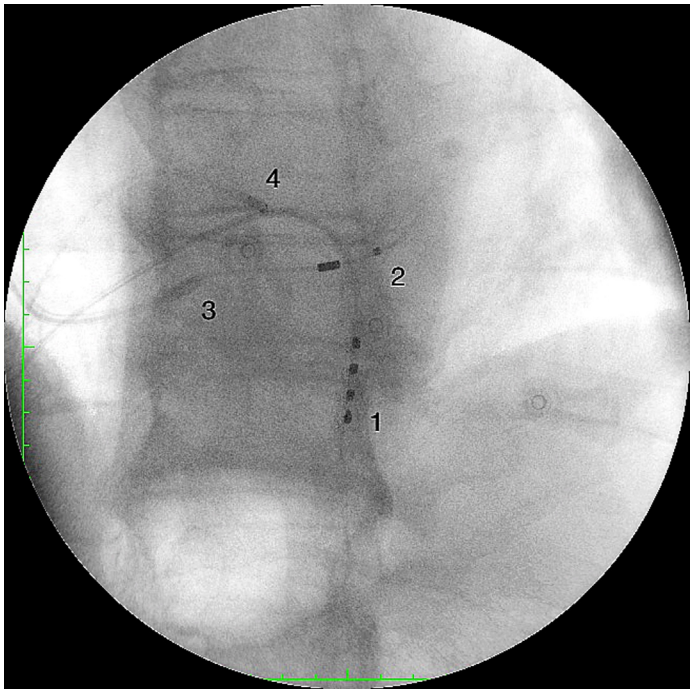
The given case outlines the close interconnection between several clinical problems exacerbating HF

FIGURE 3 **Mapping and Ablation in RVOT and Aortic Cusps**



Electroanatomical mapping of distal RVOT (1), proximal RVOT (4), and left (2) and right (3) coronary cusps and tagging of His bundle region (5) were done. Because conventional ablation attempts appeared ineffective, bipolar ablations with radiofrequency vector from left coronary cusp to distal RVOT (blue arrow) and then between right coronary cusp and more proximal RVOT (yellow arrow) were done, which resulted in complete elimination of clinical PVCs. Red points represent ablation spots in RVOT, gray in the aortic cusps, green tags of the conduction system, black spots of the arrhythmia elimination in RVOT. RVOT = right ventricular outflow tract; other abbreviations as in Figure 1.

FIGURE 4 Placement of the Pacing Lead to the Left Edge of the Interventricular Septum



This figure shows left oblique angiographic view of permanent pacing lead implantation results: quadripolar catheter (1) in the RV apex for the temporary pacing throughout the procedure; permanent pacing lead (2) was screwed deep into the interventricular septum far left to the projection of the temporary pacing catheter's tip with the fulcrum sign, the process was guided by the lead's angiographic positions, changes in QRS morphology and pacing impedance; guiding catheter (3) withdrawn to the level of tricuspid valve and ready for cut-off; intracardiac echocardiographic catheter (4) in RV inflow tract to assist visualization of permanent lead septal penetration. Abbreviations as in Figure 2.

and the necessity to make online adaptation of the strategy in the case of unusual complication. The presented patient needed CRT and this is an established method of treating HF combined with LBB block.[1] Frequent PVCs can reduce the effects of CRT, thus decreasing PVC burden can improve CRT results and RFA is a preferable way of PVC elimination.[2,3] Because anatomical restrictions, intramural or epicardial location, and scarring can diminish the success rate, use of alcohol, bipolar ablation, half-saline, and multisite ablation have been proposed.[4-6] The bipolar RFA adapted in our case could be a viable option for PVC ablation in special areas such as the LV summit and septal regions providing deeper lesions.

AV block is a well-known complication of open-heart surgery in up to 6% of cases with more than 2% receiving pacemaker implantations. Among patients who would recover from AV block, 90% did so before the end of the first week.[7] Contrary to the fact that AV block is usually uncommon and transient during diagnostic electrophysiological procedures and likely caused by direct mechanical catheter trauma of the conduction system, cases of persistent AV block are extremely rare.[8] The presented case was suddenly complicated by inadvertent persistent AV block with catheter trauma as the likely explanation. Using deep LV septal-LBB pacing gave the possibility to simplify the procedure workflow with comparable classical CRT outcomes.[9]

Bipolar ablation impairing AV conduction was a possibility because bipolar ablation energy application is far less controlled than the traditional one. However, it was not very likely because vectors of bipolar ablations were quite distant from the initially mapped conduction system.

FOLLOW-UP

After 1 month the intrinsic AV conduction returned with a reduction of pacing to 85%-88%. Because the patient's condition had improved, he refused AV nodal ablation to achieve strict rate control. Pacing parameters remained stable at 1, 3, 6, and 12 months of follow-up; no acute or delayed complications were seen. At 12 months the PVC daily burden was reduced to 500/d, NYHA was functional class II, left ventricular ejection fraction increased to 48%, and his 6-minute walking test was 340 m.

CONCLUSIONS

Encountering a rare complication of complete distal AV block during RVOT mapping changed the initial staged treatment plan in this patient. The case was successfully managed by using bipolar RFA between aortic cusps and RVOT under temporary right ventricular pacing followed by deep LV septal-LBB pacing and implantation of a VVIR pacemaker in the same procedure timeline.

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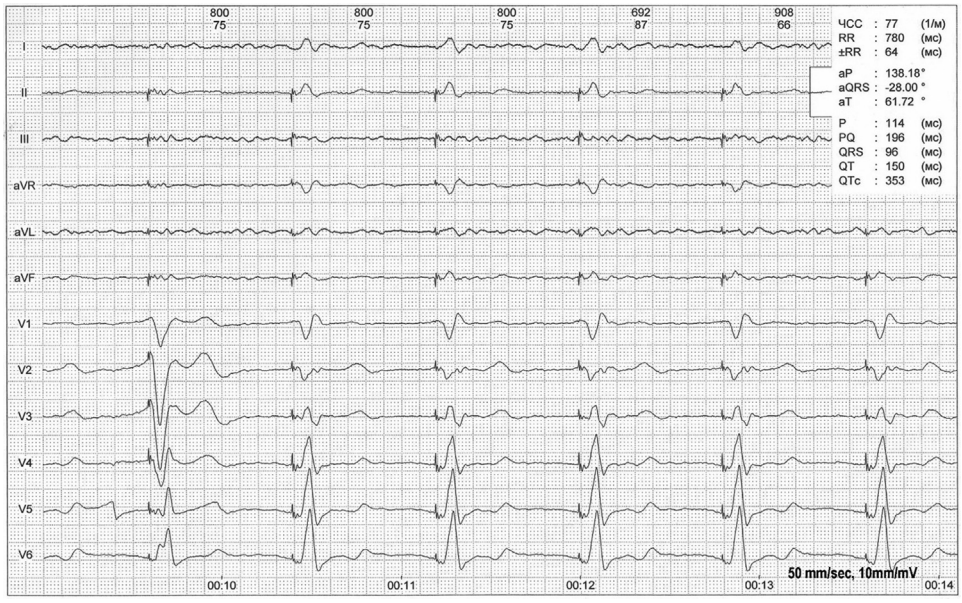
FIGURE 5 **Final ECG Results of the Procedure**



VVIR deep LV septal pacing in unipolar mode with appropriate pacing parameters (threshold: 0.4 V; R waves: 7-9 mV; impedance: 620 ohms) was associated with significant shortening of QRS duration (120 ms) and balanced electrical axis; isoelectric interval between pacing spike and QRS onset (10 ms), spiky QRS morphology, and appropriate LV activation time (65 ms) pointed out for the LBB conduction system involvement. Sporadic "late" fused PVCs (first beat) can be noted. LV = left ventricular.

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