An intriguing case of alternating bundle branch block pattern post dual-chamber pacemaker implant: Unexpected complication during pacemaker implantation

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Introduction

Right bundle branch block (RBBB) morphology in postpacemaker electrocardiogram (ECG) has been well defined.[1] Inadvertent left ventricular pacing following attempted placement of a lead in the right ventricle is a known occurrence. Possible explanations of a paced RBBB-pattern QRS post pacemaker implantation are lead placement in the middle cardiac tributary of the coronary sinus, lead placement via subclavian artery into the left ventricle, lead placement via patent foramen ovale or atrial septal defect or ventricular septal defect into the left ventricle, lead perforation of the right ventricular (RV) apex or interventricular septum, and, rarely, RV apical pacing.[2–6] It is important to differentiate safe RBBB patterns from those caused by septal or free wall perforation.

In this case report, we present a case of RBBB morphology post dual-chamber pacemaker (DDDR), secondary to active fixation right atrial (RA) lead across the tricuspid valve in membranous septum, which is something different from previously described causes.

Case report

A 60-year-old woman underwent a dual-chamber pacemaker implant for symptomatic degenerative high grade atrioventricular (AV) block with a wide QRS left bundle branch block (LBBB)-morphology escape rhythm (Figure 1A). The lead parameters at time of implant were reportedly normal. The patient presented to us after 1 month for a clinical review. The 12-lead ECG showed alternating bundle branch block pattern (Figure 1B). What is the pacemaker malfunction?

KEYWORDS Alternating bundle branch block; Dual-chamber pacemaker; Electrocardiogram; Electrogram; Paced right bundle branch block
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KEY TEACHING POINTS

- The 12-lead electrocardiogram (ECG) is a reliable and rapid means of diagnosing pacemaker malfunction.
- Right bundle branch block morphology in postpacemaker ECG warrants careful evaluation.
- ECGs and electrograms should correlate during device interrogation.

Discussion

The 12-lead ECG shows 2 different morphologies of QRS: predominantly the RBBB pattern with inferior axis along with an intermittent LBBB pattern with superior axis (Figure 1B). The LBBB pattern, occurring at an interval of around 60 beats per minute (bpm), seems to have a constant relationship to the RBBB pattern of QRS. The P waves are dissociated, suggesting possible undersensing of the atrial lead. The RA and RV leads were reportedly placed at the RA appendage (RAA) and RV apex, respectively, as shown in the fluoroscopy images (Figure 2A–C). The LBBB pattern of the QRS could be explained by the intermittent apical RV lead pacing. The RBBB-pattern QRS could be an intrinsic escape rhythm of the conduction system; however, this does not account for the constant relationship of the alternating bundle branch block patterns to each other. An alternative explanation, though quite rare, could be that the RBBB pattern is also a paced QRS morphology.

The 12-lead ECGs were performed in the AAI and VVI mode to understand the paced morphology of each of the implanted leads. The RA lead was found to pace the ventricle leading to the RBBB pattern found in the ECG (Figure 2D). Given the position of the RA lead in the

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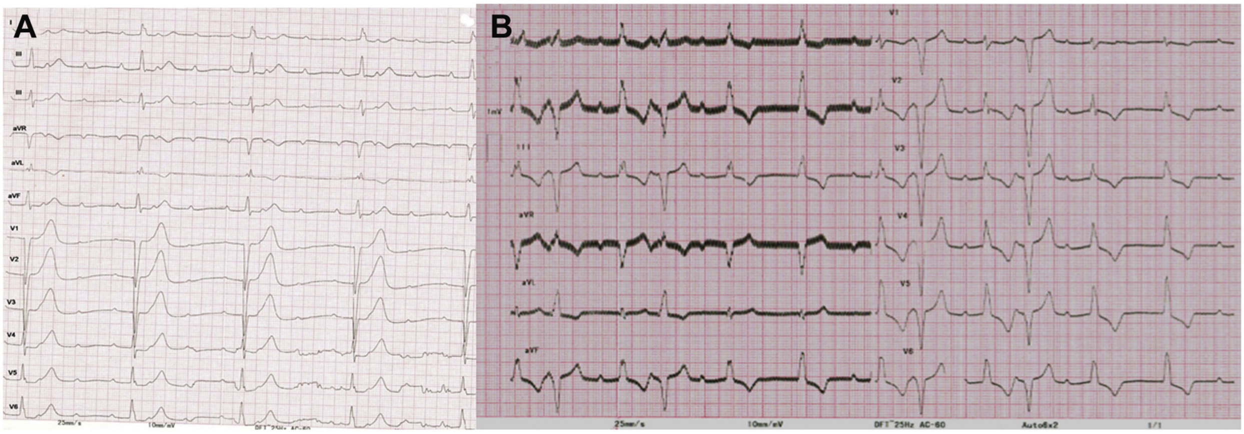

Figure 1 **A:** The 12-lead electrocardiogram showing high-grade atrioventricular (AV) block with a wide QRS left bundle branch block (LBBB) morphology escape rhythm with heart rate of 30 beats per minute. **B:** The 12-lead electrocardiogram (post DDDR) showing 2 different broad complex morphologies, right bundle branch block and LBBB, resembling alternate bundle branch block with complete AV dissociation.

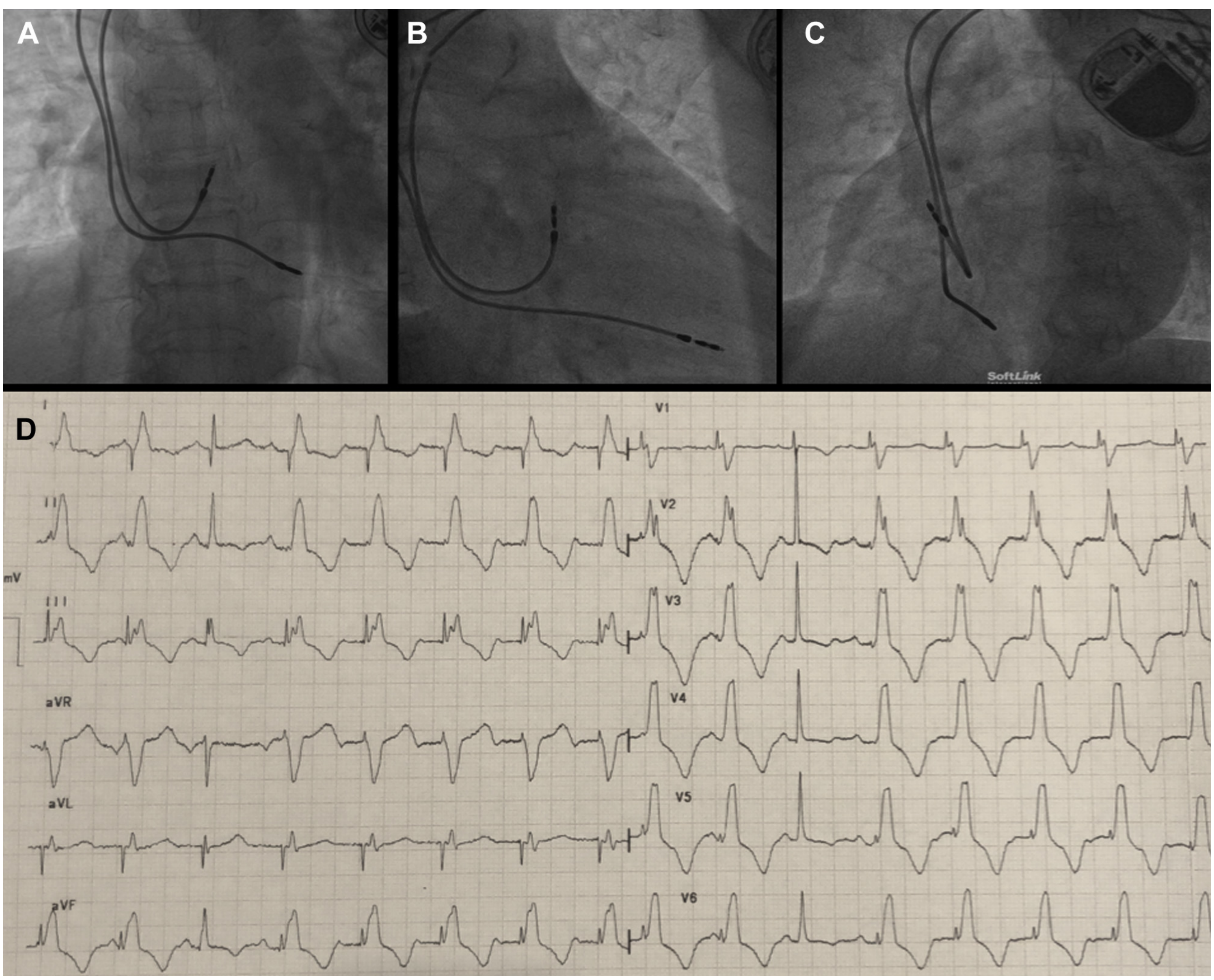

Figure 2 **A–C:** Fluoroscopy images in anteroposterior, right anterior oblique, and left anterior oblique views showing active fixation atrial and ventricular leads. Right atrial lead appeared to be in right atrial appendage. **D:** A 12-lead- electrocardiogram in AAI mode of dual-chamber pacemaker showing right bundle branch block morphology with inferior axis and complete atrioventricular dissociation.

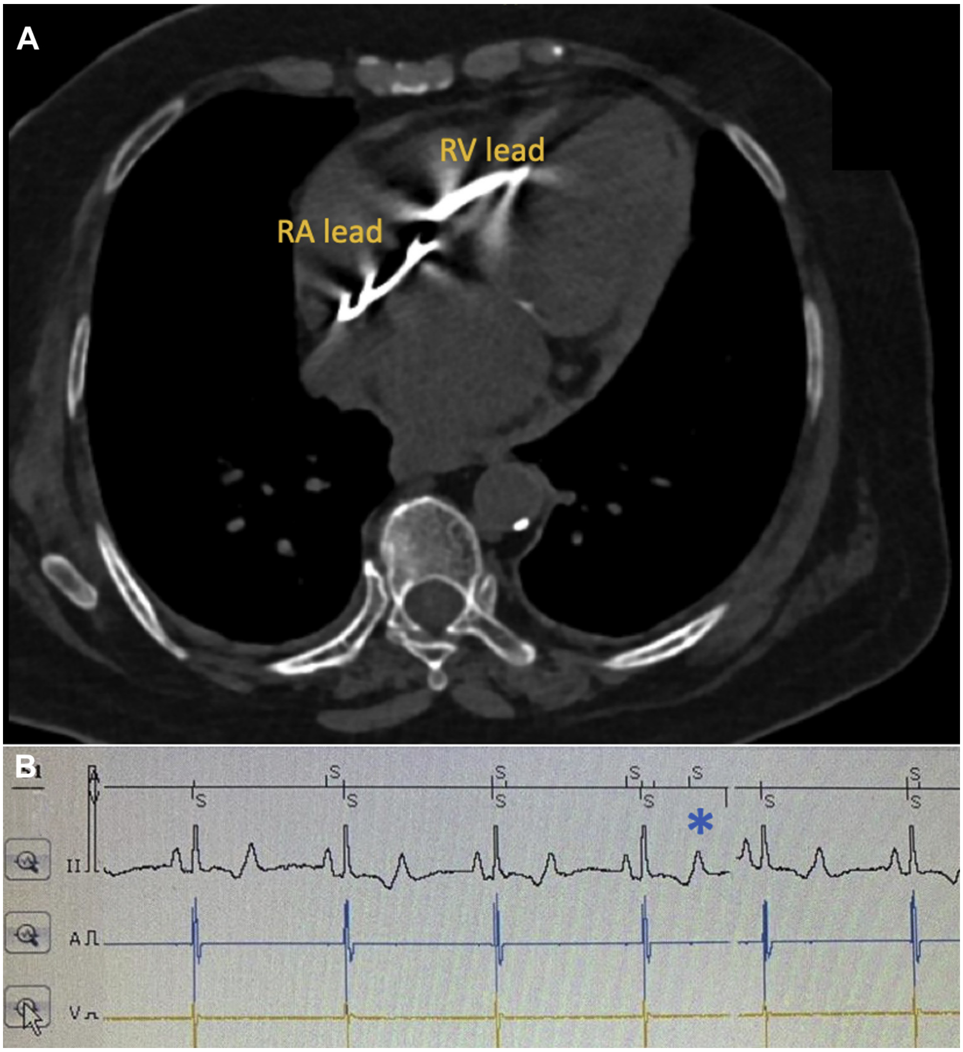

Figure 3 **A:** Axial noncontrast high-resolution computed tomography image of chest showing right atrium (RA) and right ventricle (RV) lead. The position of active fixation RA lead was across the tricuspid annulus in membranous septum. **B:** Electrogram showing simultaneous sensing of atrial (blue color) and ventricular (yellow color) signals. Blue asterisk implies T-wave sensing by the atrial lead.

fluoroscopy images (Figure 2A–C), which was superior and anterior, the only logical explanation that could be arrived upon was that the RA lead being placed in the RV outflow tract and possible screwing of the lead deep into the membranous ventricular septum led to the LBB capture by the pacing lead. Bedside echocardiography confirmed the position of the RA lead across the tricuspid annulus into the AV septum. The lead position was further confirmed in computed topography, which showed atrial lead position near the tricuspid annulus into the AV septum (Figure 3A). The set lower rate of 60 bpm is evident as the RBBB pattern is at a constant interval of 60 bpm (600 ms) in the ECG. The constant relation of the LBBB pattern to the RBBB pattern can be explained by the T-wave sensing and tracking by the RV lead (Figure 3B). The RV lead capture following pacing by the RA lead or during the ventricular safety pace is concealed on the ECG as it falls in the refractory period of the ventricle. The patient was taken for a revision of the atrial lead, which was repositioned at the RAA.

The importance of electrograms during pacemaker insertion and in follow-up of patients cannot be overemphasized. The windshield wiper movement on the fluoroscopy, though classical of RAA movement, is also seen with tricuspid annular movement and hence could have deceived the operator performing the device implant. A comprehensive step-by-step evaluation of 12-lead ECGs and correlating each of the findings with imaging and interrogation prevent the complications. Electrograms had proved decisive in understanding the alternating bundle branch block pattern in the patient who had come for a routine clinical review after implant of a dual-chamber pacemaker. Active fixation leads screwed deep into the ventricular septum can lead to LBB capture resulting in an RBBB pattern of paced QRS. It is better to confirm the position of leads in multiple views. Squara and colleagues[7] revealed the importance of individualized left anterior oblique (LAO) projection instead of the generic LAO 40°. Individualized LAO projection has 100% sensitivity and 89.5% specificity for the prediction of RV lead position. To achieve the individualized LAO projection, first LAO 40° projection is done and progressively adjusted by 5-degree increments until the superior vena cava–inferior vena cava guidewire (posterior landmark) is perfectly superimposed with the tip of the RV lead (apical landmark).[7] Therefore, in LAO view, the RA lead if properly positioned will be at the 10–11 o'clock position, while the RV lead will be at the septal, apical, free wall, or outflow tract position, depending on the position in individualized LAO view.

Conclusion

The 12-lead ECG is a rapid, reliable means of diagnosing pacemaker malfunction. ECG, electrogram, and echocardiography help us in localizing lead position and managing pacemaker malfunction.

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