An unusual case of ventricular resynchronization from endocardial right ventricular apex

Carla Favoccia, MD,[1] Massimo Stefano Silvetti, MD,[1] Gabriele Rinelli, MD,[1] Aurelio Secinaro, MD,[1,3] Sonia Albanese, MD,[1,2] Fabrizio Drago, MD[1]

From the [1]Pediatric Cardiology and Cardiac Arrhythmia/Syncope Unit, Bambino Gesù Children's Hospital IRCCS, Rome, Italy, [2]Cardiac Surgery Unit, Department of Pediatric Cardiology and Cardiac Surgery, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy, and [3]Advanced Cardiothoracic Imaging Unit, Bambino Gesù Children's Hospital, IRCCS, Rome, Italy.

Introduction

Right ventricular apical pacing or left bundle branch block (LBBB) may cause left ventricular (LV) dyssynchrony and dysfunction. Alternative pacing sites, including conduction system pacing, have been proposed to prevent or reduce LV dysfunction in young patients with complete atrioventricular block.

Case report

A 27-year-old patient with congenital heart disease presented to our center with left persistent superior vena cava, bicuspid aortic valve, aortic coarctation, and subaortic membrane. The patient had a long surgical history, including coartectomy; subaortic membrane resection; aortic valve replacement with biological prosthesis; aortic root enlargement with pericardial patch; and aortic valve replacement with mechanical prosthesis. Later, due to mediastinitis and endocarditis, he also underwent valved homograft implantation at the aortic site.

After the last surgery, postoperative first-degree atrioventricular block with LBBB (Figure 1A) and intermittent second- and third-degree atrioventricular block occurred (Figure 1B).

Echocardiography showed severely impaired left ventricular function (LV ejection fraction 30% and global longitudinal strain –10%) with septal dissynchrony. According to postoperative anatomy, the operators initially planned to perform a mid-septum or conduction system pacing implantation with a stylet-driven lead from the right side due to persistence of left superior vena cava. However, the transvenous ventricular lead initially reached the right ventricular apex (RVA) in septal position and a pacing test showed right bundle branch block (RBBB) morphology of paced QRS. Fluoroscopy and echocardiography performed during the procedure confirmed the RVA position, excluding the left ventricular apex (LVA) position erroneously. Moreover, systolic function seemed to improve at echocardiography. Therefore, the ventricular lead tip was implanted in the RVA position. The patient underwent dual-chamber pacemaker implantation (DDD 60–170 beats/min). Postoperative electrocardiogram (ECG) (RBBB and left axis deviation) and chest radiograph confirmed procedure results (Figure 2A and 2B). The ECG pattern did not change during ventricular output pacing and polarity (uni- and bipolar) changes. Computed tomography scan showed the lead tip positioned

KEY TEACHING POINTS

- Post-surgical anatomy is always challenging and usually increases the difficulties of device implantation. In this case, the left superior vena cava precluded left-sided access and probably made it more difficult to obtain biventricular pacing. However, the right and left apical mutual relationship allowed a fortuitous electromechanical resynchronization.
- When approaching these patients with congenital heart disease, a complete knowledge of postsurgical anatomy is required.
- In cases of apparently strange paced QRS complex for the fluoroscopy position of the tip of the leads, the intraoperative use of echocardiography may be useful.

KEYWORDS Cardiac pacing; Adult congenital heart disease; Pacing complications; Systolic function; Atrioventricular block
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Address reprint requests and correspondence: Dr Carla Favoccia, Pediatric Cardiology and Cardiac Arrhythmias Complex Unit, Bambino Gesù Children's Hospital, Scientific Institute for Research, Hospitalization and Healthcare, Via Torre di Palidoro 1, 00050 Palidoro-Fiumicino, Rome, Italy. E-mail address: carla.favoccia@opbg.net.

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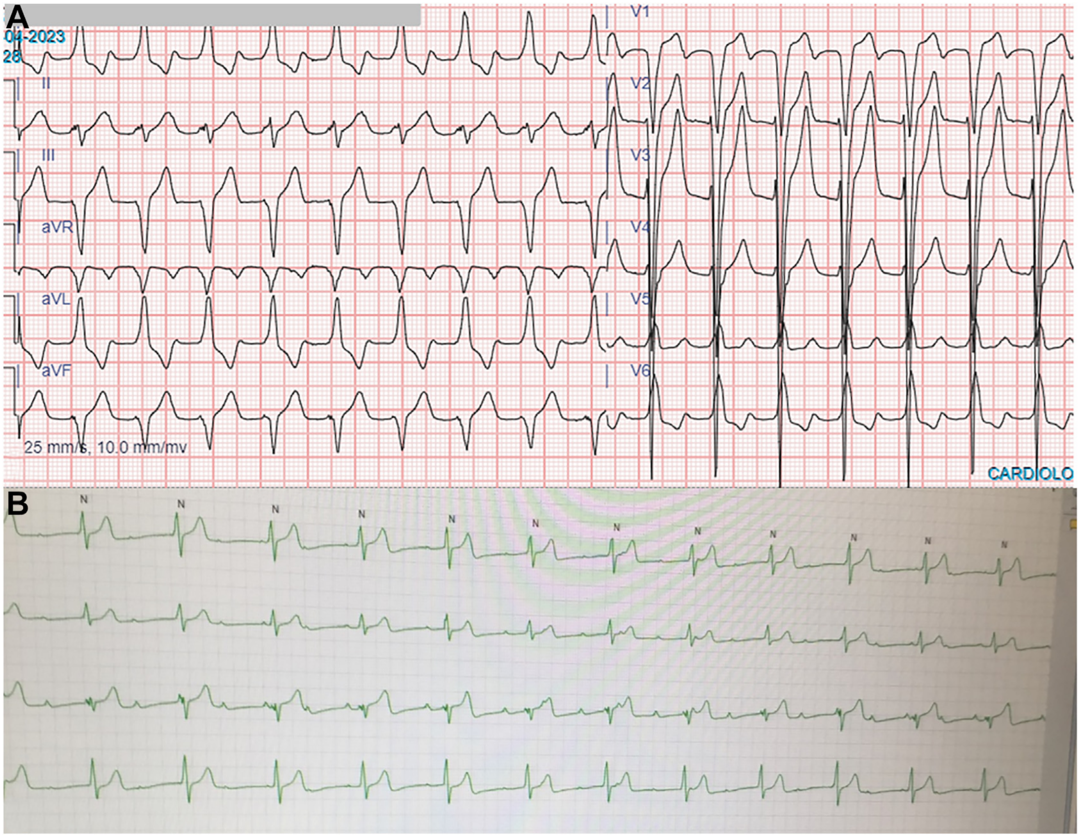

Figure 1 **A:** Electrocardiogram showing postoperative first-degree atrioventricular block with left bundle branch block. **B:** Electrocardiogram monitoring showing third-degree atrioventricular block.

in right ventricle (RV) apical endocardium close to the LV most external apical wall (Figures 3 and 4). Despite RVA position, a thorough echocardiography examination showed an improved LV systolic function (LV ejection fraction 60% and global longitudinal strain –18%), with mild residual interventricular septal hypokinesia, probably related to surgery. ECG and echo patterns were stable at 8-month follow-up.

Discussion

Several studies have focused on the deleterious consequences of RVA pacing on left ventricular function, mediated by pacing-induced ventricular dyssynchrony and systolic dysfunction.[1,2] RV pacing produces an LBBB pattern on paced QRS. On the contrary, LV pacing causes an RBBB pattern on QRS. To overcome RV pacing–induced dysfunction, conduction system pacing was developed, either close to His bundle, or close to LBB area. In this latter case, RBBB is obtained through deep pacing in the interventricular septum, with good LV electromechanical function. In small children, good results have been found with epicardial LVA pacing, which shows RBBB and superior axis deviation.[3]

In the current case report, despite a typical RVA lead position, an RBBB pattern of paced QRS was obtained. An inappropriate lead position in the LV was excluded by fluoroscopy and echocardiography during the implant procedure and later confirmed by computed tomography scan. Good electromechanical LV function was found, with relevant improvement of systolic function in comparison with LV function observed during postoperative LBBB. This improvement may be due to the lead tip position in RVA, which is very close to LVA. As a matter of fact, RVA seems to slide under LVA (Figures 3 and 4) and thus, ventricular pacing stimulates an ECG pattern similar to that obtained with LVA epicardial pacing.[3] Alternatively, it can also be assumed that even in the RVA, deep wall pacing may recruit LBB fibers.[4] Both of these mechanisms would improve LV function.

Conclusion

This RV lead position determined an unexpected and fortuitous case of resynchronization and improvement of a failing LV. This result could be rarely reproducible due to the peculiar postsurgical anatomy of this patient. Only a similar anatomic relationship of the cardiac apex could predict similar success.

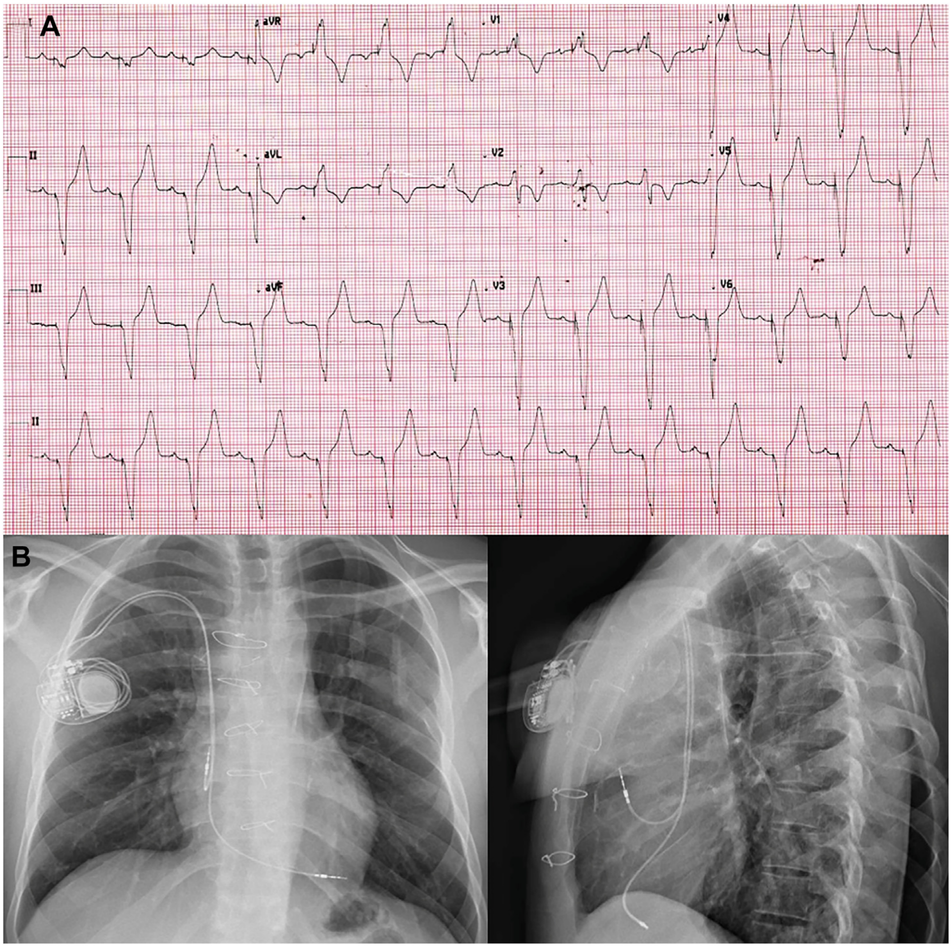

Figure 2 **A:** Electrocardiogram showing right bundle branch block and left axis deviation. **B:** Chest radiograph showing the lead positioned in right ventricular apex.

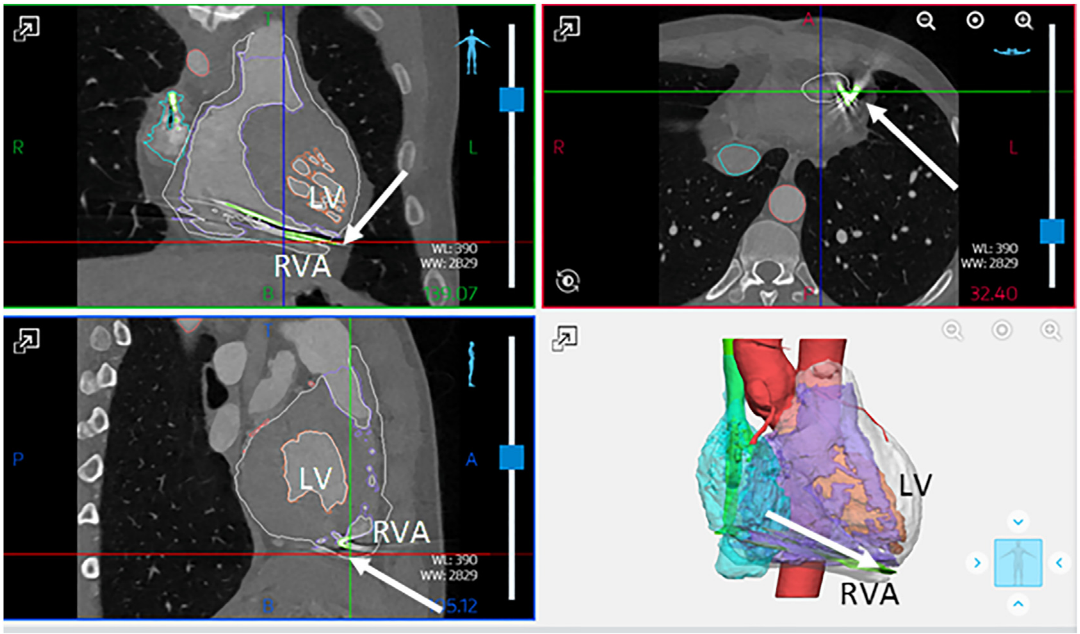

Figure 3 **A:** Computed tomography scan showing the tip (white arrow) of ventricular lead (green in color), positioned in right ventricular apical (RVA) endocardium very close to the left ventricle (LV) most external apical wall.

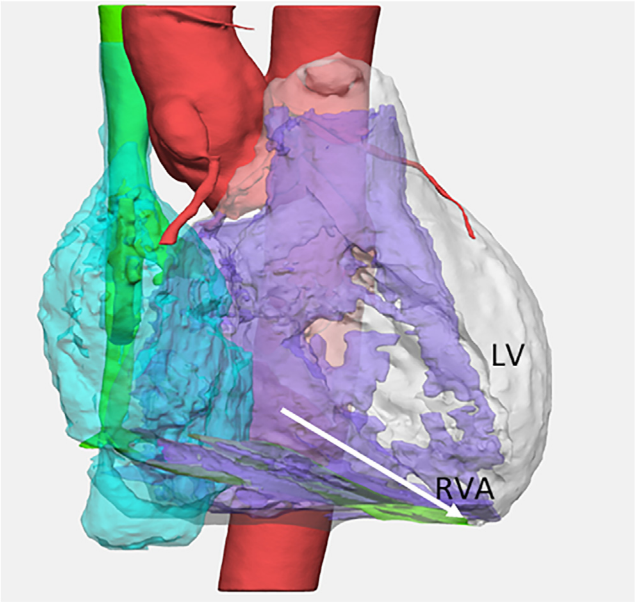

Figure 4 Magnification of computed tomography scan. The right ventricle is colored in violet. LV = the left ventricle; RVA = right ventricular apex.

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