Right ventricularly paced right bundle–type pattern on ECG: Does this preclude upgrading to biventricular pacing?

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Introduction

Right ventricular endocardial pacing is expected to exhibit a left bundle branch pattern on ECG. However, a right bundle branch block (RBBB) pacing pattern is seen in 8% to 22% of cases.[1–3] This has been called a pseudo-RBBB pattern. Biventricular pacing is utilized to resynchronize ventricular contraction in patients with a reduced ejection fraction. It is used for cases with a native left bundle branch block (LBBB), or a right ventricularly paced LBBB morphology. Resynchronization therapy has not been found useful in patients with a native RBBB pattern.[4] The effect of resynchronization therapy in treating patients with a paced RBBB morphology has not been addressed. We report on 2 cardiomyopathic patients with implanted dual-chamber pacemaker/defibrillators who displayed an RBBB ventricularly paced electrocardiographic morphology, and were upgraded to biventricular pacing, with positive results.

Case reports

Case 1

The subject is a 90-year-old man with a dual-chamber pacemaker implanted in April 2012. Pre-upgrade left ventricular ejection fraction was 34% in a nonischemic cardiomyopathy. The patient was 100% AV paced. Electrocardiogram (ECG) showed a right bundle ventricularly paced pattern. Upgrade by the addition of a coronary sinus (CS) lead was performed in April 2015. At the time, an apical right ventricular lead positioning was noted on fluoroscopy, with the lead tip on the distal septum. There was no unusual cardiac rotation. An echocardiogram performed in July 2016 showed normal left ventricular systolic function with an ejection fraction of 61%.

KEYWORDS Biventricular pacing; Cardiomyopathy; Pseudo–right bundle pattern; RBBB; Ventricular resynchronization
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KEY TEACHING POINTS

- A right bundle branch block paced pattern can be seen in V_1 on electrocardiogram (ECG) in up to 22% of patients despite true right ventricular pacing.
- Moving the V_1 ECG recording electrode to the fifth intercostal interspace exposes the expected left bundle branch block paced pattern.
- The right bundle branch block paced pattern on ECG is predominantly a pseudo–right bundle pattern and therefore does not preclude upgrade to biventricular pacing if required.

Case 2

The subject is an 86-year-old man with a cardiomyopathy of coronary artery disease. He has a history of a prior implantable cardioverter-defibrillator implanted for rapid ventricular tachycardia in May 2012. His initial left ventricular ejection fraction was within normal limits. After the development of complete heart block years later, his left ventricular ejection fraction dropped to 35%, associated with persistent right ventricular pacing, The ECG showed a right bundle ventricularly paced pattern. This is demonstrated on the left of Figure 1. A CS pacing lead was added in a lateral branch of the CS in September 2016. The right ventricular defibrillator lead positioning was noted fluoroscopically as apical and septal at the time of the upgrade, as seen in Figures 2 and 3. The heart does not appear to be appreciably rotated. Subcutaneous emphysema can be seen on the radiograph, but there is no overt pneumothorax. (Note that the ECGs in Figure 1 were recorded remotely from the device upgrade, so there would be no impact of the chest radiograph finding on the ECGs.) His ejection fraction 3 months after the implant increased to 38% by echocardiogram and 41% by gated single photon emission computed tomography and there was associated symptom improvement.

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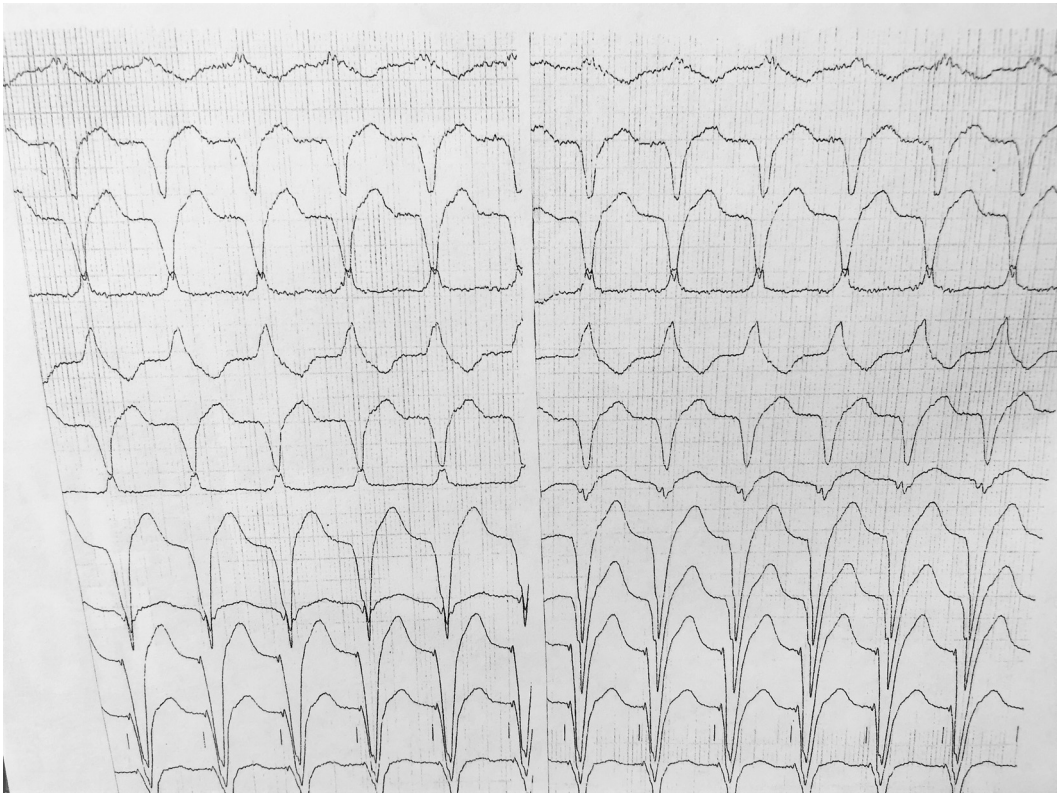

Figure 1 A "split screen" of the electrocardiogram from case 2 is displayed. Right ventricular pacing recorded with V_1 electrode in the second interspace is on the left side of the figure; right ventricular pacing recorded with V_1 electrode in the fifth interspace is seen on the right. The only manifest difference is in lead V_1—the QRS complex is upright on the left panel, down-going in the right panel.

Discussion

Despite a baseline right bundle-type paced pattern on ECG, the left ventricular ejection fraction improved in both patients with the addition of a CS lead for biventricular pacing. The differential diagnosis for an RBBB morphology of the right ventricularly paced QRS complex includes conditions where the electrode is placed in the left side of the heart (eg, lead placement via a patent foramen ovale or via an atrial or ventricular septal defect). Perforation of the right ventricular myocardium by the pacing lead resulting in epicardial pacing on the left side would give the same picture. Another cause would be pericardiophrenic vein cannulation with lateral left ventricular epicardial pacing. Inadvertent cannulation of the CS to the distal CS or distal middle cardiac vein could give the same picture, as would cannulation of a persistent left superior vena cava with distal CS pacing. A deeply placed septal lead screw tip with premature activation of the left bundle was suggested as another cause.[5] Lastly, severe disease of the right bundle conducting system could result in earlier penetration of the paced electrical impulse into the left ventricular conduction system, with a resultant RBBB pattern on ECG.[6,7]

The above scenarios are rare, however. The more likely explanation is that the tip of the pacing electrode is in the most posterior portion of the right ventricle, on the interventricular septum, relatively far from the chest wall and early precordial chest leads (ie, V_1–V_3).[6,7] Klein and colleagues[2] reported that recording an ECG with the V_1 and V_2 leads in the fifth or sixth intercostal space unmasks an LBBB pattern with true apical right ventricular pacing.[2] This maneuver was performed in both patients. Results were

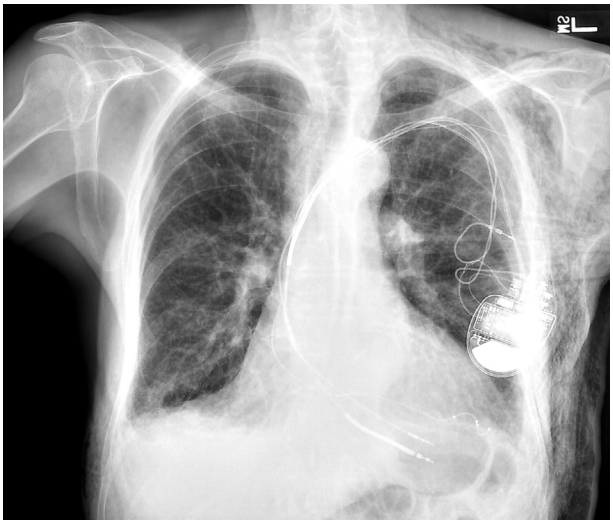

Figure 2 A posteroanterior chest radiograph from case 2 is shown with 4 pacemaker leads. One lead is in the right atrium, 1 is in the coronary sinus, and 2 are in the right ventricle (RV). One RV lead is capped. The second RV lead is the thicker electrode and is active in the defibrillation and sensing systems. It is in an appropriate apical and septal position.

Figure 3 A lateral chest radiograph from case 2 shows the defibrillator lead in the septal position. The coronary sinus lead can be seen posteriorly.

essentially identical. Representative ECG recordings from case 2 can be seen in Figure 1. The standard V_1 recording resulted in a right bundle paced pattern. However, placing the V_1 lead in the fifth intercostal space resulted in an LBBB-type paced configuration on the ECG in V_1. When utilizing this technique, if an LBBB pacing pattern is unmasked, then usual resynchronization response rates could reasonably be expected with the upgrade. The biventricular pacing in both patients resulted in a tall R wave in V_1 and V_2 (recorded in the second interspace). The current 2 cases do not provide information in the rare case of a true unexplained RBBB paced pattern persisting despite lower interspace recording. Before a biventricular upgrade is performed, it would seem prudent to perform the ECG maneuver of lower V_1 and V_2 electrode recordings as described above. If an LBBB pacing pattern is not uncovered, further investigation as to the position of the right ventricular lead is warranted.

Conclusion

In conclusion, in cases where there is an RBBB paced pattern on the baseline ECG in the presence of true right ventricular pacing, a required upgrade from right ventricular pacing to biventricular pacing can reasonably be performed. One could anticipate the customary clinical response rates associated with the biventricular pacing modality. Further study is warranted.

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