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【 CASE REPORT 】

Earlier Right Ventricular Pacing in Cardiac Resynchronization Therapy for a Patient with Right Axis Deviation

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Abstract:

We describe the case of a 37-year-old woman who presented with complete right bundle branch block and right axis deviation. She was admitted to our hospital due to severe heart failure and was dependent on inotropic agents. Cardiac resynchronization therapy was initiated but did not improve her condition. After the optimization of the pacing timing, we performed earlier right ventricular pacing, which led to an improvement of her heart failure. Earlier right ventricular pacing should be considered in patients with complete right bundle branch block and right axis deviation when cardiac resynchronization therapy is not effective.

Key words: heart failure, cardiac resynchronization, right bundle branch block, right axis deviation, optimization pacing

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Introduction

Cardiac resynchronization therapy (CRT) is effective in patients with heart failure (HF) and left ventricular (LV) dyssynchrony. However, previous studies have indicated that it is not an adequate treatment option in approximately 30% of patients with HF (1). Left bundle branch block (LBBB) has been shown to predict a favorable response to CRT (2), but the benefits of CRT in patients with complete right bundle branch block (CRBBB) or nonspecific intraventricular conduction delay have not been clearly demonstrated. We herein report the case of a patient with CRBBB and right axis deviation (RADEV) whose LV dysfunction showed improvement following the implantation of a CRT device and the optimization of her pacing timing.

Case Report

A 34-year-old woman presented to our hospital with acute decompensated HF at 38 weeks in her first pregnancy. An echocardiogram indicated LV dysfunction (LV ejection fraction, 20%). The baby was immediately delivered by caesarean section. After the caesarean section, the patient was diagnosed with dilated cardiomyopathy based on several extensive studies, including myocardial biopsy and coronary angiography, and optimal medical therapies were prescribed, including an angiotensin converting enzyme inhibitor and a beta blocker.

Three years later, the patient was admitted to our hospital due to severe HF [serum brain natriuretic peptide (BNP) level, 1,400 pg/mL], and was dependent on inotropic agents. Electrocardiography revealed CRBBB and RADEV, which was indicative of a left posterior fascicular block. Two-dimensional speckle tracking tissue Doppler imaging revealed no significant time difference in the peak strain and no evidence of typical mechanical dyssynchrony (Fig. 1). On the 46th day of hospitalization, we implanted a CRT device with a defibrillator function (Viva XT, Medtronic, Minneapolis, USA). After the initiation of biventricular pacing with earlier LV pacing, the patient's HF gradually worsened. At eight days after the initiation of CRT, we conducted the

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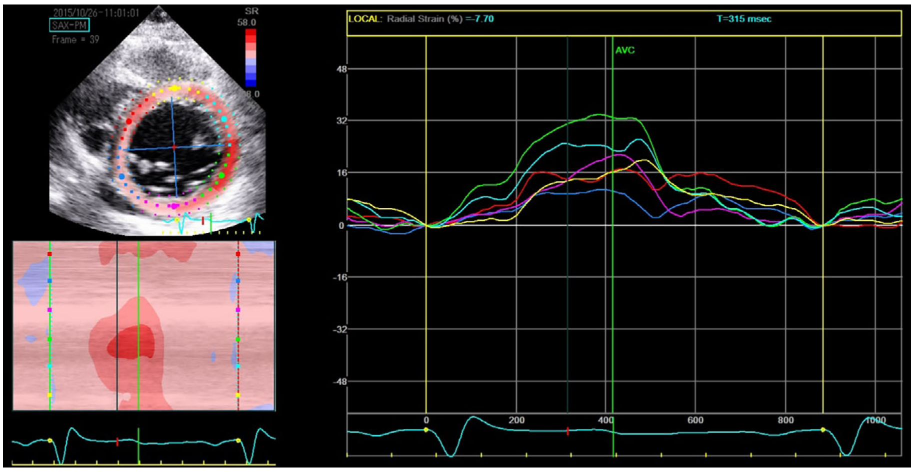

Figure 1. Two dimensional speckle tracking tissue Doppler imaging. Imaging was taken before cardiac resynchronization therapy implantation and shows no significant time difference in peak strain and demonstrates no evidence of typical mechanical dyssynchorony.

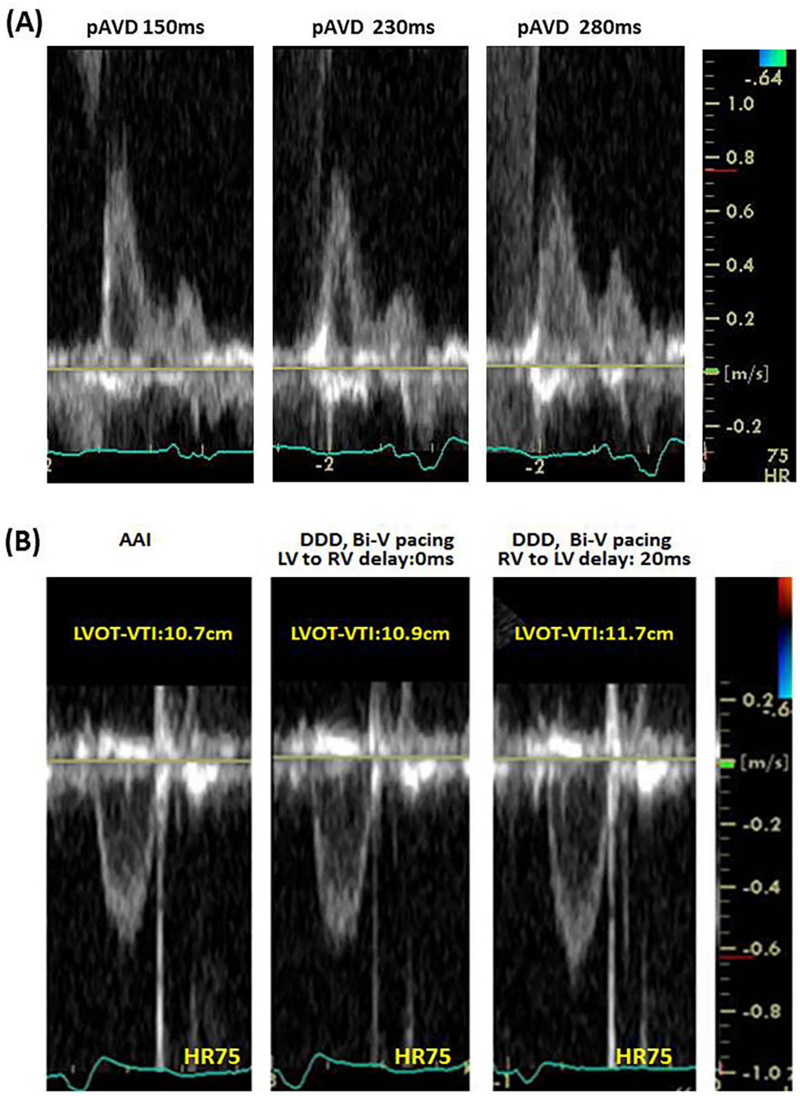

Figure 2. Serial examination images of echocardiogram in pacing timing optimization. (A) At the optimal A-V delay (paced A-V delay: 280 ms), E and A wave separation without truncation of the A wave was obtained; (B) RV earlier pacing of CRT increases cardiac output estimated by a velocity time integral of LV outflow tract. CRT: cardiac resynchronization therapy, RV: right ventricular, LV: left ventricular

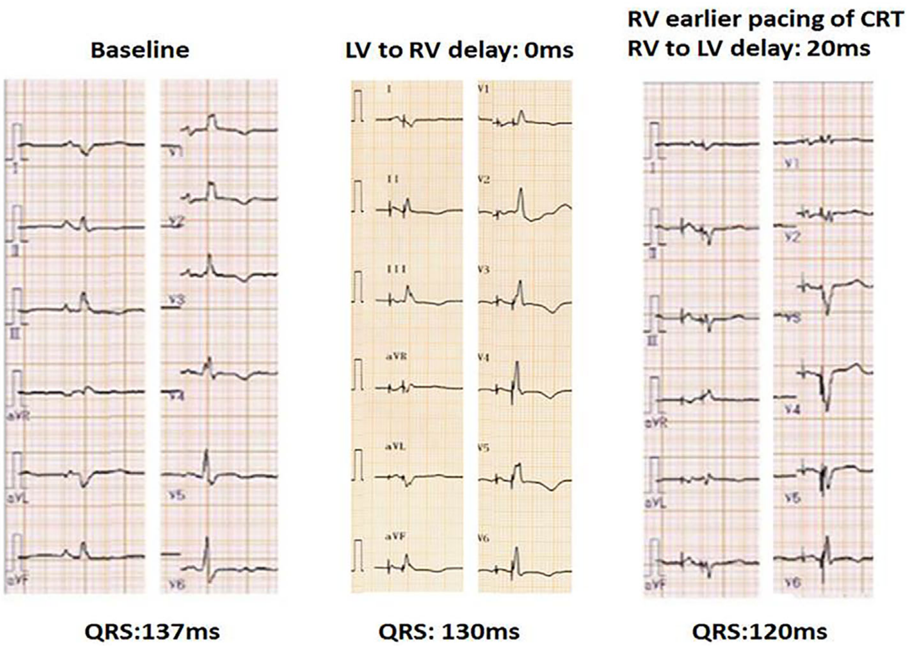

Figure 3. Serial examination images of surface electrocardiogram. The ECG showed shorting of the QRS width, and changes of the QRS morphology and axis by appropriate setting (RV to LV delay: 20 ms). ECG: electrocardiogram, RV: right ventricular, LV: left ventricular

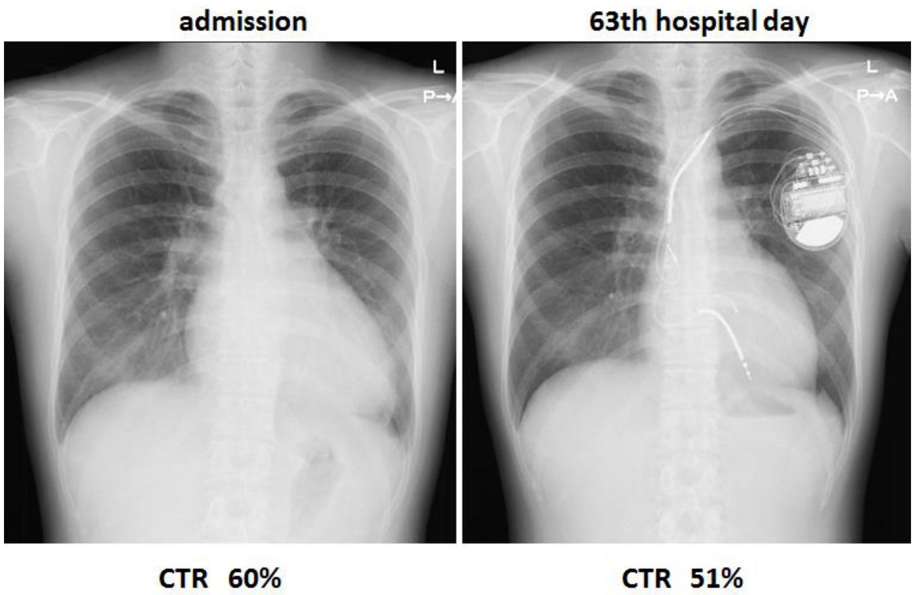

Figure 4. Comparison of chest radiography findings before and after CRT implantation. Chest radiograph of the admission day (left side) shows pulmonary congestion and cardiac enlargement. After CRT implantation and optimization, these findings improve (right side). CTR: cardiothoracic ratio, CRT: cardiac resynchronization therapy

optimization of pacing timing using echocardiography to determine whether biventricular pacing should be used. The echocardiogram indicated that earlier right ventricular (RV) pacing increased her cardiac output, which was estimated based on the velocity time integral of the LV outflow tract after the adjustment of AV timing (Fig. 2). Electrocardiogram (ECG) showed the shortening of the QRS width and changes in the QRS morphology with the appropriate setting (Fig. 3). After the initiation of biventricular pacing with earlier RV pacing, her clinical status showed a dramatic improvement. A chest radiograph revealed that this included a decreased BNP level (563 pg/mL) and a decreased cardiothoracic ratio (60% to 51%) (Fig. 4). Finally, inotropic agents could be completely withdrawn without a worsening of the patient's HF.

Discussion

In the past decade, CRT has become an important treatment modality for patients with severe HF and a wide QRS width. However, up to one-third of patients with HF may not experience any improvement in their clinical status and/or a reversal of cardiac remodeling after CRT (1). The majority of patients enrolled in CRT trials were diagnosed with LBBB and the benefits of CRT in patients with other QRS morphologies have not been clearly demonstrated. In addition, the duration of QRS has been shown to be a positive predictor of a CRT response in patients with LBBB; however, little is known about its predictive value in non-LBBB patients.

Brenyo et al. showed that left axis deviation (LADEV) in patients with non-LBBB is not associated with an increased benefit from CRT (3). However, we previously reported that - among patients with a nonspecific intraventricular conduction delay - LADEV at baseline and a QRS axis shift from LADEV to RADEV after CRT were more frequently observed among CRT responders (4). LADEV is indicative of left anterior fascicular block, which may lead to an LV antero-lateral activation delay. In such cases, earlier LV pacing with appropriate timing is important for improving the local dyssynchrony in the LV anterolateral wall. However, among patients with CRBBB and RADEV, which are indicative of left posterior fascicular block, the activation wave conducts from the left anterior fascicule to the right and inferior aspects and may lead to significant conduction delays in the LV inferior septal area. Although earlier RV pacing may exacerbate the RV and the LV functions, earlier RV pacing delivered from the appropriate lead position and timing, is effective for improving the local dyssynchrony in the LV inferior septal area in patients with CRBBB and RADEV. After pacing, effective conduction is indicated by an axis change, as shown in the present case (Fig. 3). It is difficult to optimize the pacing timing based on the results of surface ECG alone.

It is also important to consider ADEV in patients with non-LBBB without global LV dyssynchrony. However, since various conditions may cause RADEV, including acute or chronic right ventricular overload, lateral wall myocardial infarction and left posterior fascicular block, we have to be aware of the possibly that RADEV may represent a more complicated situation than LADEV because of its relationship to local dyssynchrony.

Lastly, a previous study revealed that cardiac dyssynchorny was observed in 59% of the patients with nonspecific intraventricular conduction delay and 40% of patients with RBBB (5). These findings may support different conclusions in non-LBBB patients who undergo the implantation of a CRT device. Furthermore, echocardiography does not always reveal LV mechanical dyssynchrony correctly, and we cannot use it to predict the response of patients with non-LBBB and RADEV to CRT. Thus, we should make a precise adjustment of the pacing timing, including the V-V delay and the A-V delay, and consider earlier RV pacing as an option in non-responders with CRBBB and RADEV, as described in our case.

Conclusion

In patients with CRBBB and RADEV who do not respond to CRT, a precise adjustment of the pacing timing, including both the V-V delay and the A-V delay, is important. Earlier RV pacing should be considered as a treatment option for improving LV dysfunction.

The authors state that they have no Conflict of Interest (COI).

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