IMAGES IN CARDIOLOGY

Cardiac Resynchronization Via Left Ventricular Anterior Wall Pacing

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Abstract

A case of cardiac resynchronization is presented with paced-QRS narrowing effected via a left ventricular (LV) lead placed at an anterior cardiac vein after failed implantation at the lateral wall due to phrenic nerve stimulation. Data are presented indicating that an anterior LV pacing site selection may not be that bad after all, particularly when biventricular pacing from this position produces a QRS that is narrower than the baseline native QRS. ***Rhythmos*** 2018;13(1): 13-15.

Key Words: cardiac resynchronization therapy; heart failure; left bundle branch block; dilated cardiomyopathy; left ventricular lead; phrenic nerve stimulation; anterior left ventricular lead position

Abbreviations: CRT = cardiac resynchronization therapy; CRT-D = CRT-defibrillator; ECG =electrocardiogram; LBBB = left bundle branch block; LV = left ventricular; NYHA = New York Heart Association

A 67-year-old lady with a 10-year history of non-ischemic dilated cardiomyopathy presented with gradual worsening of her heart failure symptoms from New York Heart Association (NYHA) class II to NYHA class III-IV over the preceding several months despite optimal medical therapy comprising an angiotensin converting enzyme inhibitor, a mineralocorticoid antagonist, a beta blocker and a diuretic. A recent echocardiogram showed deterioration of left ventricular (LV) systolic function with an ejection fraction of ~33% and moderate mitral regurgitation. ECG showed a left bundle branch block (LBBB) morphology with a QRS duration of 144 ms (**Fig**. 1). Additional symptoms included palpitations caused by ventricular ectopy (up to runs of non-sustained ventricular tachycardia on ambulatory ECG) which was not fully suppressed by amiodarone therapy. Recent myocardial scintigraphy was normal. Due to worsening heart failure symptoms the patient was referred for cardiac resynchronization therapy (CRT). A CRT-defibrillator (CRT-D) device was chosen to be implanted.

During the implantation procedure, placement of a quadripolar LV lead into two available small posterolateral coronary sinus tributaries led to phrenic nerve stimulation from all four poles tested and with all possible combined configurations, despite obtaining adequate pacing thresholds. Thus, the lead was finally placed in an anterior cardiac vein (**Fig**. 2 & 3) as there was no other alternative.

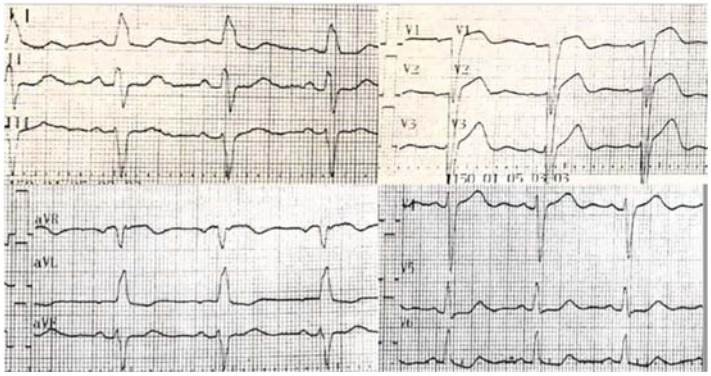

Figure 1. Baseline ECG showing left bundle branch block (LBBB) with a QRS width of 144 ms.

In this position, there was no stimulation of the phrenic nerve, while the pacing threshold was borderline (2.5V @ 0.5 ms). Importantly, biventricular pacing from this position and the right ventricular lead led to narrowing of the paced QRS to 120 ms when the V-V delay was set at 10 ms with right ventricular pacing preceding the LV pacing by 10 ms (**Fig**.3). No complications occurred during the post-procedural course. Patient reported clinical improvement over the ensuing two weeks.

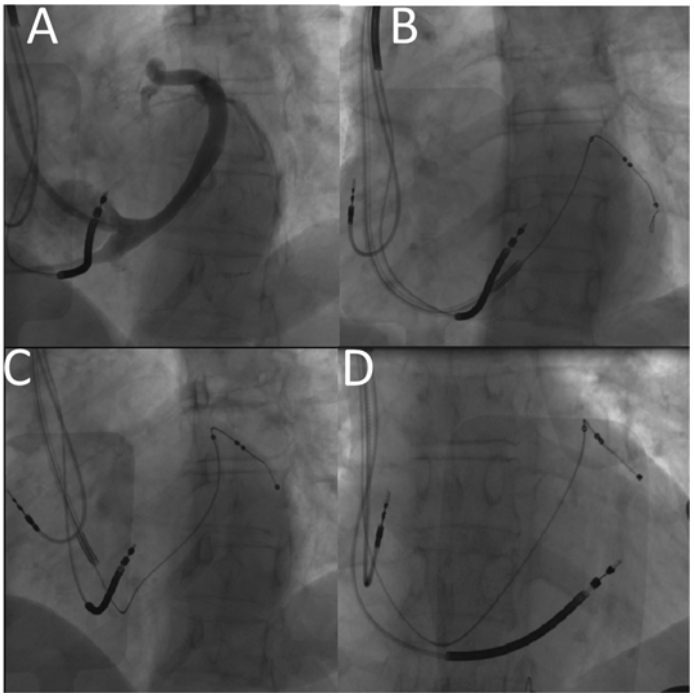

Figure 2. Coronary sinus venogram displaying paucity of posterolateral veins (panel **A**); insertion of the quadripolar lead into two different small branches of lateral veins (panels **B** and **C**) was associated with phrenic nerve stimulation at all four poles and different configurations tested. Finally, the lead was inserted and successfully tested into an anterior vein (panel **D**). Left anterior oblique views are shown in panels A-C and a right anterior oblique view in panel D.

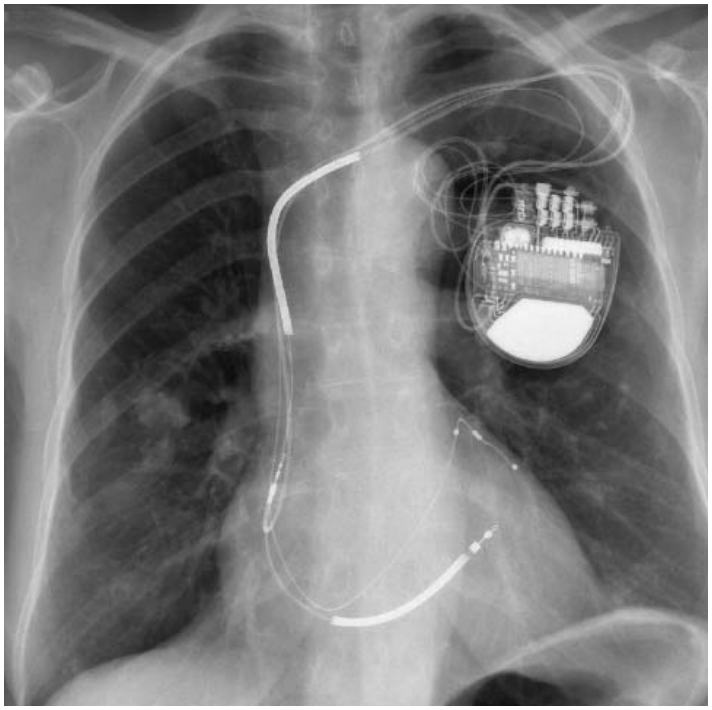

Figure 3. An anteroposterior chest X-ray view displaying the left ventricular quadripolar lead placed in an anterior coronary vein together with the standard right ventricular (RV) pacing-defibrillating lead placed at the RV septum and the right atrial lead placed at the right atrial appendage, and the CRT-D device in the left infra-clavicular area.

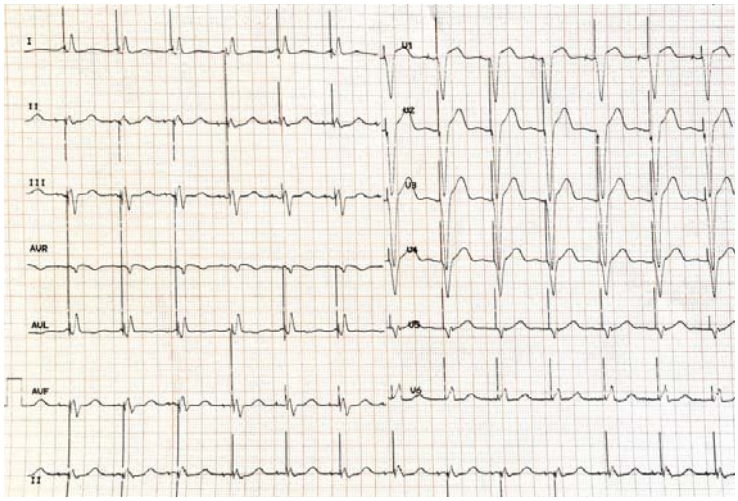

Figure 4. A 12-lead ECG is displayed of biventricular pacing from the anterior LV lead and the RV lead displaying a narrower QRS of 120 ms compared with the baseline QRS in Fig. 1.

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Earlier studies indicated that lateral or posterolateral LV lead positions were associated with greater benefit of CRT compared to anterior lead locations.[1-4] Thus, CRT when no lateral pacing option exists, as in our case, remains problematic. An anterior LV lead location has been considered suboptimal and undesirable.[5] However, a shortened QRS width during biventricular pacing has been considered as a surrogate of optimal cardiac resynchronization and a predictor of favorable clinical outcome. In the present case, a narrower QRS compared with the baseline ECG was finally obtained with biventricular pacing from an anterior LV position (Fig. 4) and this was deemed a desirable acute target.

According to a meta-analysis of 12 studies comprising 1545 patients, shortening of the QRS duration after CRT device implantation is associated with a favorable clinical and echocardiographic response.[6] These results were also confirmed by a subsequent study of 311 patients indicating that patients with a greater decrease in QRS duration after CRT initiation showed greater echocardiographic reverse remodeling and better clinical outcome.[7] The authors concluded that QRS narrowing is an easy-to-measure variable at the time of pacing site selection or pacing configuration programming that could be used to predict CRT response.

Quadripolar LV leads have facilitated CRT with the increasing number of possible combinations available to allow for adequate capture thresholds and to avoid phrenic nerve stimulation,[8, 9] however, to no avail in this particular case. Thus, before abandoning CRT, [9] a left anterior position was tested and found to be quite favorable as biventricular pacing from this position led to narrowing of the biventricular-paced QRS, accepted as a surrogate predictor of acute and possibly chronic response to CRT. Of course, one needs long-term follow-up to confirm this postulation.

The above notwithstanding, newer trials have refuted the notion that anterior lead locations may be suboptimal. Among 77 patients wherein the LV lead was implanted at the anterior or anterolateral wall in 23 patients, the responder rate (69%) was not inferior compared to the response rate (96%) at a lateral or posterolateral wall location in 54 patients.[10] Thus, the authors of that study concluded that in case of failed implantation at the lateral or posterolateral wall, positioning the LV lead in a more anterior location appears to be a reasonable alternative. Similar results were reported by larger trials. In the MADIT-CRT trial (n=799), it was the apical lead location that conferred an unfavorable outcome rather than an anterior versus a lateral lead position. Indeed, the extent of CRT benefit was similar for leads in the anterior, lateral, or posterior position; however, the apical lead location compared with leads located in the non-apical position (basal or midventricular region) was associated with a

significantly increased risk for heart failure/death (hazard ratio=1.72; P=0.019).[11] Similarly, in the RAFT trial (n=447), chest X-Ray-defined apical LV lead position was associated with a higher risk of heart failure hospitalization (hazard ratio, 1.99; P = 0.004).[12]

In keeping with these latter studies, a favorable result, as evidenced by QRS narrowing, was obtained in our patient by placing the LV lead in a basal, albeit anterior, wall location. Whether such an approach constitutes an alternative option for patients in whom a lateral lead position is non-feasible or unobtainable, or whether this may become part of a routine strategy to seek sites, regardless of anterior or lateral location, where a narrow QRS is achievable, remains to be tested and confirmed by long-term follow-up of patients enrolled in future randomized controlled studies. Anyway, current evidence from observational studies is encouraging indicating that QRS narrowing after CRT may be the desirable target, as it appears to be an important predictor of echo-cardiographic and clinical response to CRT.[6, 7] The importance of obtaining a narrow biventricular-paced QRS is also ascertained by studies indicating that para-Hisian or His-bundle pacing that achieves a narrow QRS may constitute an alternative to CRT in heart failure patients.[13-15]

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