

## Not Enough QRS Shortening? Keep Calm and Add Another Lead

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### Abstract

Cardiac resynchronization therapy (CRT) diminishes symptoms and reduces hospitalization and mortality in patients with heart failure, LV dysfunction and left bundle branch block. However, up to one third of patients do not respond to CRT. In that regard, few initial studies presenting multisite pacing have shown encouraging results, demonstrating both feasibility and safety in placing a second CS lead in >80% of patients intended, with further QRS shortening, which is the most powerful predictor of LV reverse remodelling.

**Keywords:** Multisite pacing; Atrial fibrillation; Heart failure

### Introduction

Cardiac resynchronization therapy (CRT) diminishes symptoms and reduces hospitalization and mortality in patients with heart failure, left ventricular (LV) dysfunction and left bundle branch block [1]. However, up to one third of patients do not respond to CRT. In that regard, few initial studies presenting multisite pacing have shown encouraging results [2], demonstrating both feasibility and safety in placing a second CS lead in >80% of patients intended, with further QRS shortening, which is the most powerful predictor of LV reverse remodeling [3]. Such optimization of the resynchronization therapy might be able to improve the percentage of responders to CRT when applied to selected patients. We present here A 71-years-old male with dilated cardiomyopathy, complete left bundle branch block, heart failure and severe LV dysfunction was referred to our institution for biventricular device implantation. He had a previous history of aortic mechanical prosthesis implantation and permanent atrial fibrillation. A bipolar 6F S-shaped LV lead (Medtronic 4296<sup>®</sup>) was placed on a suboptimal anterior cardiac vein. As expected we could not achieve an appropriate intraoperative QRS narrowing despite multiple programing options were tested in terms of pacing vectors and interventricular delay. Being the patient in permanent AF we decided to use the atrial port of the pulse generator in order to perform multipoint stimulation and further shorten the QRS. A small posterolateral vein allowed us to advance an identical LV lead until an optimal mid-apical posterolateral position. Multipace stimulation configuration displayed a dramatically shortening of the QRS compared with standard optimized biventricular pacing with each of the two CS leads used separately.

### Case Report

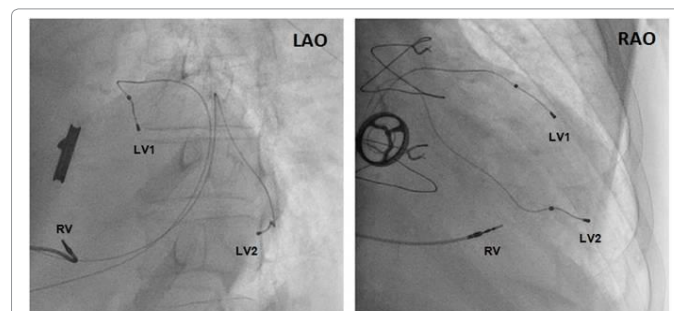
A 71-years-old male with dilated cardiomyopathy, complete left bundle branch block, heart failure and severe LV dysfunction was referred to our institution for biventricular device implantation. He had a previous history of aortic mechanical prosthesis implantation and permanent atrial fibrillation (AF). A biventricular pacemaker (Medtronic Viva CRT-P C5TR01<sup>®</sup>) was implanted as follows: once the right ventricle lead was placed in an apical position, the coronary sinus (CS) was cannulated. A bipolar 6F S-shaped LV lead (Medtronic 4296<sup>®</sup>) was placed on a suboptimal anterior cardiac vein. As expected we could not achieve an appropriate intraoperative QRS narrowing despite multiple programing options were tested in terms of pacing vectors and interventricular delay. Being the patient in permanent AF we decided to use the atrial port of the pulse generator in order to perform multipoint stimulation and further shorten the QRS. Therefore an additional CS access was made searching for a second LV lead placement. On this occasion we performed a second venography with balloon showing a small posterolateral vein not displayed during de first venography, which allowed us to advance an identical LV lead until an optimal mid-apical

posterolateral position (Figure 1). With this new scenario all possible configurations for resynchronization were tested: multisite pacing in the LV achieved the best QRS morphology, with an atrioventricular delay of 30 ms (minimum allowed) and an interventricular delay of 20 ms (LV first). This configuration displayed a dramatically shortening of the QRS compared with standard optimized biventricular pacing with each of the two CS leads used separately (Figure 2).

CRT diminishes symptoms and reduces hospitalization and mortality in patients with heart failure, LV dysfunction and left bundle branch block [1]. However, up to one third of patients do not respond to CRT. In that regard, few initial studies presenting multisite pacing have shown encouraging results [2], demonstrating both feasibility and safety in placing a second CS lead in >80% of patients intended, with further QRS shortening, which is the most powerful predictor of LV reverse remodeling [3]. Such optimization of the resynchronization therapy might be able to improve the percentage of responders to CRT when applied to selected patients.

### Discussion

In this patient we tried to place a second LV lead due a suboptimal



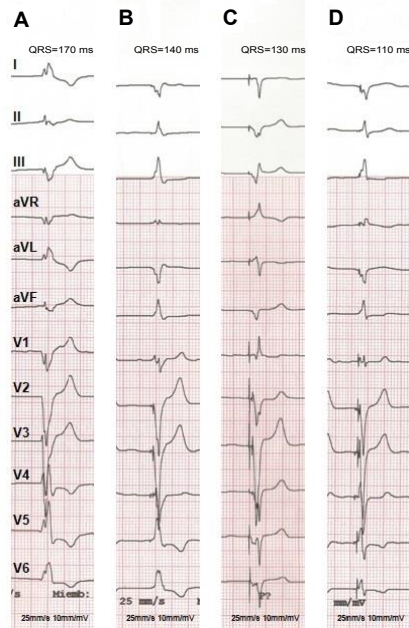
**Figure 1:** Left anterior oblique (LAO) and right anterior oblique (RAO) projections showing the three LV leads: The RV lead (RV) is placed in the right ventricle apex, the first LV lead (LV1) is placed in a mid-anterior position of the LV, and the second LV lead (LV2) is placed in an apical posterolateral position of the LV.

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**Figure 2:** Twelve-channel electrocardiogram showing (from panel A to panel D) a progressive QRS shortening when comparing all available optimal programming modes. A: Basal QRS complex showing left bundle branch block and a QRS duration of 170 ms. B: Optimized biventricular paced QRS using the anterior LV lead with an interventricular delay of 30 ms (LV first), showing a QRS duration of 140 ms. C: Optimized biventricular paced QRS using the posterolateral LV lead with an interventricular delay of 30 ms (LV first), showing a QRS duration of 130 ms. D: Optimized multisite paced QRS (110 msec) using the three ventricular leads with an interventricular delay of 20 ms (posterolateral vein before the right ventricle) and atrioventricular delay of 30 ms (anterior vein before the right ventricle).

QRS shortening with standard programming using the first LV lead. Once we achieved a proper position with the second lead and an optimal QRS shortening with multipoint pacing a decision was made to use the atrial port in order to maintain both LV leads. This technique avoids the need of connecting two leads to the same LV port by the use of special connectors, which could carry to impedance problems or early battery depletion [4]. Patients with AF are suitable for this type of “easy” triple-site pacing due to the possibility of using the atrial port for multipoint stimulation. The decision of adding a second LV lead in this type of patients can be made during the implant procedure conditioned by the amount of QRS shortening with standard biventricular pacing. Randomized trials should be performed in order to confirm this initial observation.

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