

# The Benefits of Upgrading a Pacemaker from Right-Ventricular to Biventricular Pacing in Congestive Heart Failure: A Case Report

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## Summary

*Left-ventricular based pacing has recently been reported to benefit patients with severe cardiac failure. This report describes the positive effect of additional left-ventricular pacing over a 3-month period in a 46-year-old male patient, who had received a dual-chamber device 5 years ago. The patient developed severe congestive heart failure with a NYHA functional class III. His ECG showed a left bundle branch block with a QRS duration of 160 ms. A specially designed lead was additionally placed into the left ventricle via the transvenous route. Successful biventricular pacing was achieved via the lateral coronary vein and the right ventricular apex. Three months later, the patient's clinical status had improved markedly. His functional class was reduced to NYHA II. This case shows the potential benefit of biventricular pacing vs. right-ventricular pacing in patients with congestive heart failure and left bundle branch block. Upgrading the pacemaker from a dual-chamber to a three-chamber system could be of major advantage in well selected patients, in order to improve their well-being and control heart failure.*

## Key Words

Biventricular pacing, heart failure

## Introduction

The management of chronic congestive heart failure (CHF) is of great importance to the clinical practice because of the large size of the affected population and the related socio-economical consequences. Despite optimal medical management, many patients remain markedly limited in their daily activities, and in a minority of cases, cardiac transplantation is required. No other verified treatment is available among the medical and surgical alternatives. In this context, recent data suggest that biventricular pacing therapy may have the potential to improve the functional status, especially in patients with chronic drug-refractory CHF, prolonged PR intervals, a left-ventricular ejection fraction of < 35 %, QRS complexes > 150 ms, left bundle branch block (LBBB), and NYHA class III [1-5].

This case report describes the outcome of upgrading a dual-chamber to a three-chamber pacemaker in order to realize biventricular pacing. Our patient fulfilled all the above-mentioned criteria for this new therapy.

## Materials and Methods

Five years ago, the 46-year-old male patient received a dual-chamber pacemaker (Chorus 6234, Ela, France) with two conventional leads because of third degree AV block. Over the years, the patient increasingly suffered from chronic and severe heart failure (NYHA class III), despite of drug treatment that included at least ACE-inhibitors, diuretics,  $\beta$ -blockers, and digoxin. The left-ventricular systolic dysfunction was reflected by a left-ventricular ejection fraction of 32 %. Evidence of a LBBB was indicated by a QRS duration of 160 ms. Because of the encouraging results of acute and chronic evaluations concerning biventricular pacing, we decided to treat the patient with a left-ventricular based pacing configuration.

The transvenous lead Corox LV (Biotronik, Germany) was chosen for additional left-ventricular pacing. This silicon-coated unipolar lead offers the use of a stylet (Figure 1). A ring just behind a soft distal tip serves as

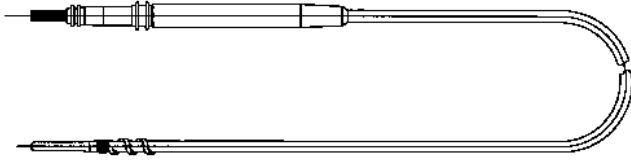


Figure 1. Corox LV lead.

the pacing electrode. Proximal to the ring is a silicon screw to ensure proper fixation.

After introducing a pre-shaped stylet into the conductor lumen of the lead, the ostium of the coronary sinus was catheterized under fluoroscopy in frontal view. The lead was then placed into the lateral vein as far as possible up to a blocked position. The position could be classified as mid-lateral (Figure 2).

Finally, we tested lead stability by respiratory maneuvers and coughing. For optimal placement, we decided to require a biventricular pacing threshold of  $< 3$  V and a sensing threshold of  $> 6$  mV. For biventricular pacing, the Corox LV lead and the right-ventricular lead were connected to the ventricular port of the DDD pacemaker via a Y-bifurcated coronary sinus adapter (Biotronik, Germany). The left-ventricular lead was connected to the positive pole (anode), and the right-

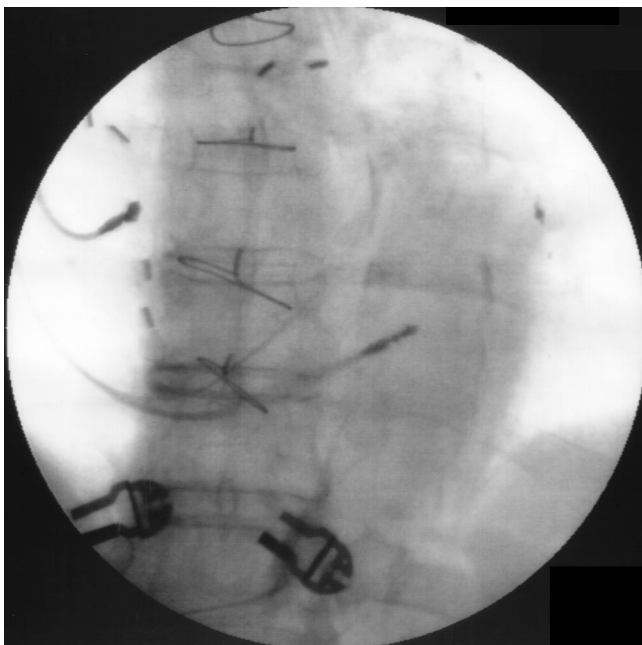


Figure 2. Anterior-posterior x-ray picture showing the mid-lateral position of the Corox LV lead.

ventricular lead, to the negative pole (cathode). In that configuration, the device worked in a conventional DDD mode with simultaneous pacing of both ventricles. Follow-up examinations were performed prior to discharge, at 6 weeks, and at 3 months.

## Results

During implantation, the biventricular pacing threshold was 2.6 V at a pulse width of 0.5 ms. The R-wave amplitude was 20 mV, and the impedance was measured at 964  $\Omega$ . The total implantation time was 105 min with an x-ray time of 76 min. Intraoperatively, we observed a significant decrease of the QRS duration to 140 ms when biventricular pacing was activated (Figure 3). The electrical parameters during follow-up remained stable with a slight decrease of the pacing threshold to 2.3 V at 0.5 ms after 3 months. After 3 months, the patient's functional status improved to NYHA class II. The left-ventricular ejection fraction increased from 32 % to 40 %, measured by echocardiography. No renewed hospitalization because of CHF was necessary in the 3-month period. A stable position of the lead was proven by a x-ray picture after 3 months.

## Discussion

Conventional DDD pacing with a short AV delay was introduced as a supplemental treatment for dilated cardiomyopathy with encouraging preliminary results [6,7]. However, these findings could not be confirmed by other controlled studies [8,9]. Nevertheless, the results demonstrated the importance of one factor: the need of a pacing mode capable of offering the most physiologic sequence of ventricular activation. These observations led to the development of multisite pacing. Its goal is to correct the electrical and mechanical asynchrony of the left heart due to an LBBB, which is frequently present in severe CHF. A great number of acute hemodynamic studies have confirmed the superiority of biventricular pacing over conventional DDD pacing for increasing dP/dt and cardiac output, as well as decreasing mean pulmonary capillary pressure [10-13]. Recent studies also showed important clinical benefits, including a decrease in mean NYHA functional class, improvement in quality-of-life scores, and a longer mean distance covered during the 6-minute walk test [5,14].

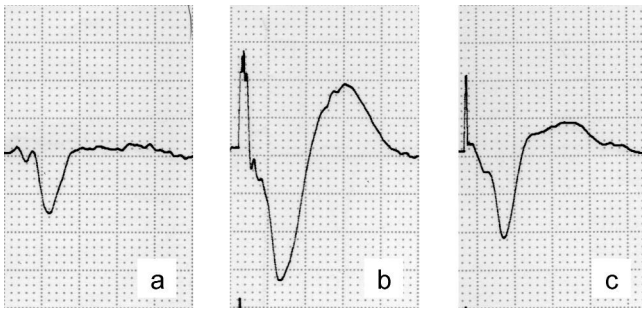


Figure 3. ECG recording (lead III) showing QRS complexes during intrinsic rhythm (a), right-ventricular pacing (b), and biventricular pacing (c).

In the presented case, the biventricular pacing configuration appears reliable. Furthermore, the implantation of the additional left-ventricular lead did not cause problems. Biventricular pacing thresholds, R-wave amplitudes, and impedance remained stable throughout the period of observation. The left-ventricular ejection fraction increased significantly from 32 % to 40 %. This case also revealed important clinical benefits, including a decrease of NYHA class by about one. The implant procedure would probably be facilitated by the availability of instrumentation dedicated to the procedure, such as a pre-shaped catheter to engage the ostium of the coronary sinus and obtain angiographic images of the cardiac venous system, which would assist in the choice of a target vein. Recent data demonstrated that a mid-position in a lateral or posterolateral vein should be preferred to achieve optimal left-ventricular dP/dt and pulse pressure [3]. A conventional approach to implanting the Corox LV lead was adopted in this case. This method, chosen for its minimally invasive nature, yielded encouraging results in early testing [15]. The epicardial approach, affixing the lead to the posterolateral wall of the left ventricle, preferable via thoracoscopy or thoracotomy, is an alternative. It offers the advantage of a wider choice of left-ventricular pacing sites. However, it is more invasive and more likely to cause intraoperative complications and a difficult postoperative recovery, as well as the possibility of postsurgical morbidity.

### Conclusion

This case demonstrated the feasibility of upgrading a dual-chamber pacemaker to a three-chamber pace-

maker in order to realize biventricular pacing, using a conventional venous access for lead introduction. There were no serious peri- or early postoperative complications associated with this approach. A learning curve must be considered, and implantation tools have to be available for shortening the intraoperative procedure and the total x-ray time, respectively. The measured favorable functional results confirmed the benefits of biventricular pacing when compared with right-ventricular pacing in patients with severe CHF and LBBB. It remains to be proven whether this therapy has a long-term effect.

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