Left ventricular endocardial pacing improves the clinical efficacy in a non-responder to cardiac resynchronization therapy: role of acute haemodynamic testing

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Recently, emphasis has been shifted from patient selection to more optimal pacing sites in non-responders to cardiac resynchronization therapy (CRT). We present a patient who was a non-responder during both acute haemodynamic testing at implant as well as clinically thereafter. After first demonstrating acute haemodynamic improvement using LV dP/dtmax during a temporary left ventricular (LV) endocardial pacing setup, a permanent LV endocardial lead was transseptally implanted with substantial and persistent clinical improvement.

Case report

A 55-year-old male with hypertension, dilated cardiomyopathy, and normal coronary arteries had heart failure Class III New York Heart Association (NYHA). The ejection fraction was 15% and the end-diastolic and systolic diameter decreased to 70 and 64 mm, respectively, with mild mitral regurgitation. The ECG showed sinus rhythm, a PQ interval of 130 ms, left bundle branch block, and QRS width of 135 ms.

A CRT system was implanted with the coronary sinus lead in a posterior branch. Other sites showed phrenic nerve stimulation or lack of capture. Following implantation, stimulation was optimized using LV dP/dtmax as previously described.1 However, no improvement could be obtained (LV dP/dtmax baseline 858 mmHg/s, after optimization 848 mmHg/s).

A year later, his condition worsened, necessitating intravenous diuretics and dobutamine. Repositioning of the left ventricular lead was considered. As no alternative branches of the coronary sinus were available and the risk of surgical implantation was considered

![Figure 1](https://example.com/figure1)

**Figure 1** (A) X-ray detail in left anterior oblique position, showing the endocardial electrophysiology catheter opposite the epicardial coronary sinus lead. (B) The LV paced endocardially from a more basal location. Corresponding values of LV dP/dtmax after optimization of the AV interval are shown.
prohibitive, left ventricular endocardial pacing was investigated in a temporary setup. For this purpose, pacing was performed with a steerable electrophysiology catheter advanced retrogradely into the left ventricle (Figure 1). A temporary pacing wire in the right atrium was used to synchronize with intrinsic or paced atrial activation. Both pacing catheters were connected through a custom-made adaptor with a dual-chamber temporary pacemaker. By simultaneously adjusting the settings of the pacemaker and CRT-D device, biventricular endocardial pacing could be obtained.

The effect of pacing at different endocardial sites was evaluated and compared with baseline and coronary sinus pacing via the CRT-D device (Figure 2). Of note, endocardial pacing opposite to the epicardial lead did not improve the LV $dP/dt_{\text{max}}$. We subsequently implanted a LV endocardial lead (SelectSecure 3830–69, Medtronic, Minneapolis, MN, USA) by a transseptal approach at the site where the previous optimal improvement was observed (Figure 3).

Five months later, the ejection fraction had improved to 45% and the end-diastolic and systolic diameter decreased to 61 and 47 mm, respectively, with only minor mitral regurgitation. Two weeks after an electric cardioversion for atrial fibrillation, but with inadequate anticoagulation (International normalized ratio 1.3), the patient had a cerebrovascular accident which resolved except for a minor aphasia. The further follow-up was uneventful and he improved to NYHA Class II, remaining so during the 12-month follow-up.

Discussion

Most attention in non-responders to CRT has been focused on patient selection. However, inadequate delivery of therapy may play an important role.

Transseptal left ventricular endocardial pacing has been shown to be an alternative in case of failed coronary sinus lead positioning, with the potential of a more unrestricted access to different pacing sites. However, there is only limited evidence of its superiority. In animals, van Deursen et al. demonstrated a better haemodynamic effect compared with epicardial pacing, also less dependent on timing and site of stimulation. Garrigue et al. found that endocardial pacing provided better resynchronization with better LV filling and systolic performance. Our result is ambivalent: endocardial pacing opposite the epicardial lead did not yield a better acute haemodynamic effect. The latter was obtained at a remote site and it might be argued...
that, if feasible, epicardial pacing at this site might have resulted in the same improvement.

Although the relation with long-term clinical benefit has not been confirmed, the LV $dP/dt_{\text{max}}$ at the respective pacing sites correlated well with the clinical response. This suggests the potential of temporary left ventricular endocardial pacing to screen non-responders for suboptimal lead position. Stimulation in other coronary sinus branches is an alternative, but this is limited by the availability of adequate side branches for permanent lead implantation.

There is a concern regarding thromboembolic complications with endocardial stimulation. A transient ischaemic attack occurred in one of the six endocardially paced patients reported by Pasquie et al.\textsuperscript{3} No complications have been described by Garrigue et al.\textsuperscript{5} and van Gelder et al.\textsuperscript{1}, although follow-up is limited. Inadequate anticoagulation was present in our patient at the time of his cerebrovascular accident, but follow-up was uneventful after resumption of adequate anticoagulation. Nevertheless, the feasibility of adequate stable oral anticoagulation seems to be mandatory.

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**References**