Successful extracorporeal membrane oxygenation weaning after cardiac resynchronization therapy device implantation in a patient with end-stage heart failure

Simon Pecha*, Yalin Yildirim, Hermann Reichenspurner and Tobias Deuse

Department of Cardiovascular Surgery, University Heart Center Hamburg, Hamburg, Germany

* Corresponding author. Department of Cardiovascular Surgery, University Heart Center Hamburg, Martinistr. 52, 20246 Hamburg, Germany, +49-40-1751681526; e-mail: s.pecha@uke.de (S. Pecha).

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Abstract

We present the case of a 46-year old male with end-stage heart failure due to ethyltoxic cardiomyopathy. The patient did not meet the criteria for heart transplantation and declined left ventricular assist device implantation. We decided to conduct cardiac resynchronization therapy defibrillator (CRT-D) implantation. Under general anaesthesia for CRT-D implantation, cardiac function worsened. Due to deteriorating haemodynamics, CRT-D implantation was aborted and emergent veno-arterial extracorporeal membrane oxygenation (ECMO) implantation was performed. Subsequent weaning from ECMO was not possible. We decided to proceed with CRT-D implantation while still on ECMO support. With biventricular stimulation, cardiac function improved promptly and the patient could be weaned from ECMO the same day.

Keywords: Extracorporeal membrane oxygenation • Cardiac resynchronization therapy • Heart failure • Cardiomyopathy

BACKGROUND

Cardiac resynchronization therapy (CRT) is successfully used in patients with end-stage heart failure (NYHA III/IV), left ventricular ejection fraction (LVEF) <35%, ventricular dys-synchrony and prolonged QRS duration (>120 ms). Although CRT is recommended in patients with chronic heart failure, in this case, we present the use of CRT-D in acute cardiac decompensation in a patient with end-stage heart failure.

CASE PRESENTATION

We report the case of a 46-year old male patient with end-stage heart failure due to ethyltoxic cardiomyopathy. Heart transplantation was contra-indicated due to continuing alcohol abuse and LV assist device implantation was refused by the patient. Despite optimal medical treatment with a beta-blocker, angiotensin converting enzyme inhibitor, loop diuretics and aldosterone antagonist, functional status remained NYHA class IV. Echocardiography revealed LV dilatation with LV end-diastolic diameter of 6.0 cm, global hypokinesis and severely reduced LVEF of 15%. Twelve-lead electrocardiogram (ECG) revealed left bundle branch block and prolonged QRS duration of 140 ms. So the patient met the inclusion criteria for CRT-D implantation.

During induction of general anaesthesia with etomidate and sufentanil before scheduled CRT-D implantation, his cardiac function worsened. LVEF dropped to 8% and right ventricular (RV) function was severely impaired. The patient required high doses of catecholamines. Oxygen saturation dropped to 60% despite mechanical ventilation with 100% oxygen. His blood pressure was 60/40 mmHg and ECG revealed sinus tachycardia at 110 bpm. Due to deteriorating haemodynamics, the CRT-D implantation was aborted and emergent veno-arterial extracorporeal membrane oxygenation (ECMO) implantation was performed through cannulation of the femoral artery and vein. During ECMO support with a flow rate of 4–5 l/min, the cardiovascular status of the patient stabilized and he could be transferred to the intensive care unit (ICU). During the following 5 days, repeated attempts to wean the patient from ECMO failed due to deteriorating haemodynamics. We decided to proceed with CRT-D implantation while still on ECMO support. A Medtronic® Maximo II CRT-D device was successfully implanted (Fig. 1). Stimulation threshold showed good results with 0.5 V/0.5 ms for the right atrium, 0.5 V/0.5 ms for the right and 1.0 V/0.5 ms for the left ventricle. Programmed atrio-ventricular (AV) delay was 180 ms and programmed ventricular stimulation time was RV-LV 0 ms. Under biventricular stimulation with 80 bpm, cardiac function improved immediately and the patient could be weaned from ECMO while still in the operating room. He was transferred to the ICU in a stable cardiovascular condition with minimal catecholamine support and extubated the same day. After 3 days, the patient could be transferred to a regular ward. Heart failure medication was continued as preoperative. AV and interventricular optimization of the CRT-D by 12-lead ECG as well as echocardiography were performed again, and confirmed the above-mentioned parameters. Further clinical course was uncomplicated and the patient was discharged from hospital after 4 weeks.
In this case, after ECMO implantation due to biventricular heart failure, CRT implantation enabled the improvement of LV function and allowed successful weaning from ECMO.

Conflict of interest: none declared.

REFERENCES


The patient has been followed in our outpatient clinic for 6 months now. During his last visit, echocardiography identified improved LVEF of 22% and the patient was in functional NYHA class II.

DISCUSSION

Many trials have shown good results of cardiac resynchronization therapy in patients with LVEF <35% and prolonged QRS duration (>120 ms) [1, 2]. Survival, clinical status and quality of life of heart failure patients can be improved by CRT implantation [1–3].

In this case, ECMO implantation was performed as a rescue procedure due to cardiac deterioration during induction of general anaesthesia for scheduled CRT-D implantation. As ECMO weaning was not successful during the following days, we conducted CRT implantation to improve LV function. Under biventricular stimulation, intraoperative echocardiography revealed increased contractility, which allowed ECMO explantation due to increased haemodynamics. Immediate CRT effects are assumed as resynchronization of contraction, which immediately improves systolic function and myocardial efficiency, reduces wall stress and mitral regurgitation. However, until now CRT has not been considered as a therapeutic option for acute decomposition of chronic heart failure. There is a small number of publications presenting the use of CRT in patients with acute cardiac decompression. Milliez et al. showed a benefit of CRT implantation in a small group of patients (n = 20) with catecholamine-dependent overt heart failure. Their patients could rapidly be weaned from catecholamines after CRT implantation and biventricular pacing [4]. Similar results were shown by Konstantino et al. [5]. No data are available for weaning from ECMO after CRT implantation. In our case report, we show the possibility, in acute cardiac decompensation, of obtaining fast improvement of LVEF, which facilitates weaning from ECMO.

CONCLUSION

In this case, after ECMO implantation due to biventricular heart failure, CRT implantation enabled the improvement of LV function and allowed successful weaning from ECMO.

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Authors: Jamil Hajj-Chahine, Christophe Jaïlly, Jacques Tomasi and Pierre Corbi
Department of Cardio-Thoracic Surgery, University Hospital of Poitiers, Poitiers, France
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Pecha et al. [1] report the interesting case of a 46-year old patient with end-stage heart failure and ventricular dys-synchrony who underwent successful implantation of a cardiac resynchronization therapy device while on extracorporeal membrane oxygenation support. This proved to have tremendous beneficial effect on the haemodynamic status of the patient who was able to be weaned from ECMO support a few hours after implantation. We would like to add a brief comment regarding the use of temporary biventricular pacing after cardiac surgery. According to the literature, little is known about cardiac resynchronization therapy in acute heart failure or in the immediate period after cardiac surgery.

Cenneson et al. [2] were the first to publish the successful use of cardiac resynchronization therapy in the early period after cardiac surgery. A 68-year-old patient with congestive heart failure and cardiac dys-synchrony had the worst outcome, and they concluded that cardiac dys-synchrony is an important determinant of postoperative outcomes in this patient population.

Permanent biventricular pacing is currently the standard of care for patients with advanced heart failure associated with left ventricular dysfunction and intraventricular conduction delay [3]. Moreover, in patients with left ventricular dysfunction and cardiac dys-synchrony undergoing coronary artery bypass grafting, the postoperative outcome is influenced by cardiac dys-synchrony. Maruskeva et al. [4] showed that patients with the most severe dys-synchrony had the worst outcome, and they concluded that cardiac dys-synchrony is an important determinant of postoperative outcomes in this patient population.

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In this case, after ECMO implantation due to biventricular heart failure, CRT implantation enabled the improvement of LV function and allowed successful weaning from ECMO.