Journal of Arrhythmia 33 (2017) 649–651

Contents lists available at ScienceDirect

Journal of Arrhythmia

journal homepage: www.elsevier.com/locate/joa

Case Report

Cardiac resynchronization therapy via transvenous approach in a 2-year-old boy with a complete atrioventricular block after a tetralogy of Fallot repair

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ARTICLE INFO

Article history:
Received 18 May 2017
Received in revised form
25 July 2017
Accepted 30 July 2017
Available online 9 September 2017

Keywords:
Transvenous CRT
Children
Heart failure
Bridging therapy

ABSTRACT

Cardiac resychronization therapy (CRT) was performed via transvenous approach in a 2-year-old boy with a tetralogy of Fallot and postoperative severe heart failure, and complete atrioventricular block treated with a dual-chamber pacemaker. Epicardial leads were unavailable because of mediastinitis and the presence of severe bilateral pleural effusions requiring continuous drainage. There were no procedural complications. Biventricular pacing was significantly effective and both mediastinitis and pleural effusions recurred. The transvenous CRT was exchanged for an epicardial CRT after 4 months because of the possibility of a venous obstruction.

1. Introduction

Cardiac resynchronization therapy (CRT) has been reported to have an effect on improving cardiac function in children. Transvenous (TV)-CRT is commonly used in adults, but is avoided in small children with congenital heart diseases because of the possibility for a venous obstruction, difficulties in extracting the leads, and the presence of a right-to-left shunt [1]. Here, we report the case of a 2-year-old boy who underwent TV-CRT as a bridging therapy for epicardial (Epi)-CRT.

2. Case report

A 2-year-old boy with a tetralogy of Fallot (TOF) and pulmonary atresia had a right ventricular (RV) infarction and complete atrioventricular block following severe RV dysfunction due to the compression of the right coronary artery after a radical operation. Following an RV outflow reconstruction and dual-chamber pacing with epicardial leads placed in the right atrial (RA) appendage and inferior wall of the RV (Fig. 1), he experienced severe biventricular dysfunction, intractable mediastinitis, and bilateral pleural effusions. The ECG exhibited a QRS duration of 156 ms and a left bundle branch block pattern during the dual-chamber pacing (Fig. 2), and echocardiography revealed a left ventricle (LV) ejection fraction (EF) of 22%.

A CRT device implantation using epicardial leads could not be performed due to the potential for a device infection. Thus, we implanted a TV-CRT in the patient at the age of 2 years and 11 months, when he had a body weight of 10 kg and height of 84 cm. The RA and RV leads (4.8 Fr lead body size, 44 cm length, bipolar lead, Screwvine; Japan Lifeline, Tokyo, Japan) were screwed into the RA appendage and the midseptum of the RV, respectively. The LV lead (4.0 Fr lead body size, 78 cm length, bipolar lead, Medtronic 4396, MN, USA) was implanted through the coronary vein using a long sheath (9 Fr, 6250 V MPX; Medtronic, Minneapolis, MN, USA). All leads were connected to the generator (Viva™ CRT-P; Medtronic, Minneapolis, MN, USA) (Fig. 1). The total operative time was 7 h, and there were no procedural complications. Biventricular pacing was significantly effective at settings of DDD (dual chamber pacing and sensing, both triggered and inhibited mode)-biventricular, a lower rate of 120 ppm, an atrioventricular delay of 80 ms, and a ventriculo-ventricular delay of 0 ms. The patient's blood pressure significantly increased from 75/40 mmHg to 120/50 mmHg just after setting the CRT, and an improvement in the LVEF of 43% and intraventricular dyssynchrony (Fig. 2), and a shortening of the QRS duration of 123 ms, were observed (Fig. 3). The TV-CRT system was later converted to an Epi-CRT system, 4 months after TV-CRT system implantation following the improvement in mediastinitis.

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http://dx.doi.org/10.1016/j.joa.2017.07.011

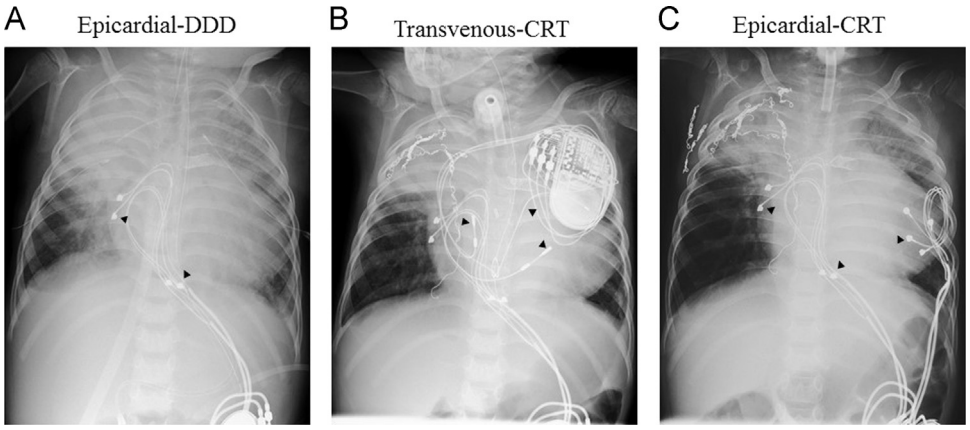

Fig. 1. Chest X ray. The black filled triangles indicate each lead. A. Epicardial (Epi)-DDD (dual chamber pacing and sensing, both triggered and inhibited mode): The epicardial leads were located in the right atrium (RA) and infero-base of the right ventricle (RV), B. TV-CRT (transvenous-cardiac resynchronization therapy): the endocardial leads are located in the RA, midseptum of the RV, and lateral wall of the left ventricle (LV) from the coronary vein. C. Epi-CRT: A lead on the lateral wall of the LV was added to the previous epicardial leads and the endocardial leads were extracted.

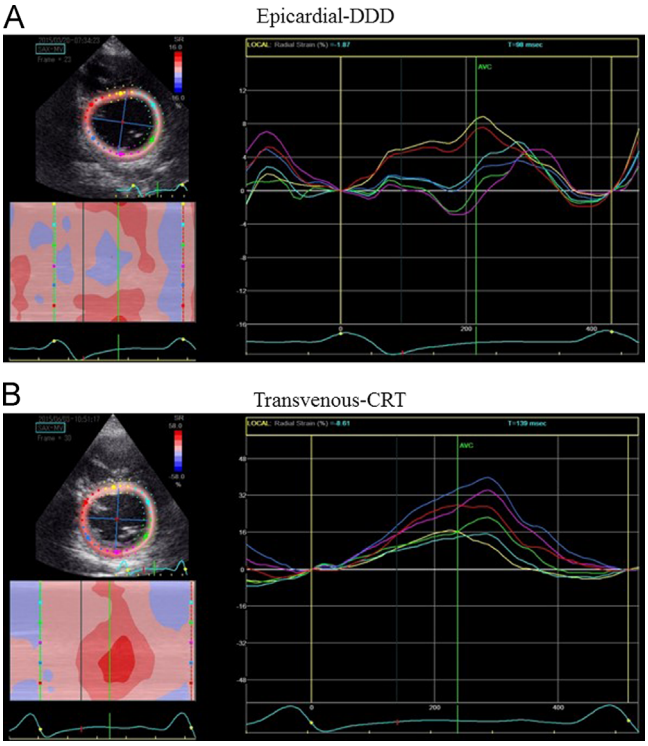

Fig. 2. Speckle tracking using echocardiography. A. Dual chamber pacing with a DDD setting: This exhibits dyssynchrony of the left ventricle, which was delayed by 203 ms on the posterior wall. B. Endocardial CRT: The previous dyssynchrony disappeared.

3. Discussion

To our knowledge, this is the first report of a 2-year-old boy who underwent the implantation of a TV-CRT as a bridging therapy to an Epi-CRT. TV-CRT has some advantages, such as offering better thresholds and being less invasive; however, they have some disadvantages such as venous obstruction, lead adhesion to vessels or valves, and thromboembolism. Epi-CRT systems are preferred due to their advantages in small children. Endocardial dual-chamber pacing is usually applied in children over a body weight of 15 kg [1]. A previous report exists on the use of a TV-CRT in a 6-year-old boy with a body weight of 22 kg [2]. Our patient also underwent a TV-CRT implantation at a body weight of only 10 kg despite some delicate points such as a secured blood vessel, cannulation with a long sheath into the coronary vein, and indwelling LV lead, and switched to an Epi-CRT as scheduled. In responders to CRT, the prognosis is not poor [3], and an Epi-CRT would be better in terms of preventing the known complications in small children. We could have considered other choices for the ventricular pacing lead to be placed in the apex or lateral wall of the LV, or for biventricular pacing to be introduced if a dual-chamber pacemaker was implanted. The pacing from the inferior wall of the RV was thought to be inferior to the pacing from the LV side in regard to the cardiac function [4]. Biventricular pacing is thought to be effective in the setting of CAVB, especially in such a case with biventricular heart failure.

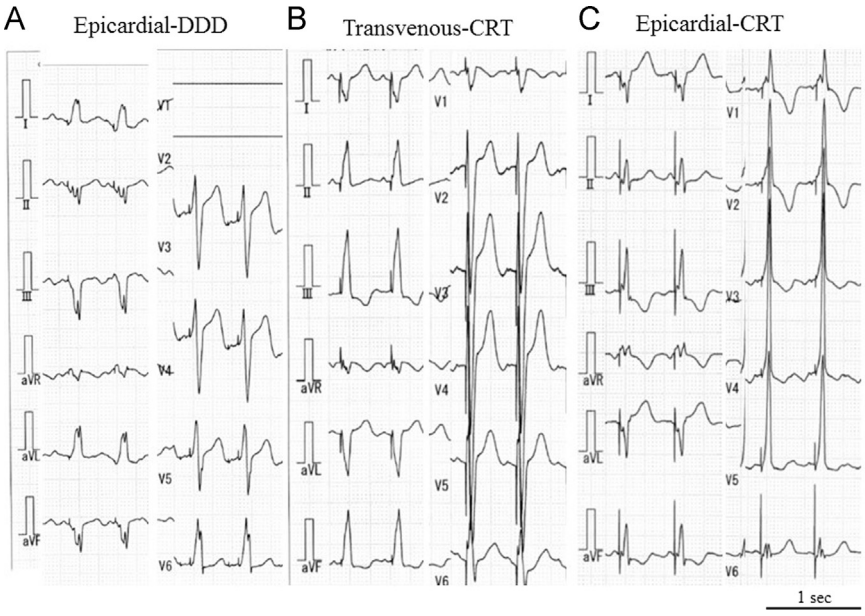

Fig. 3. Twelve-lead ECG. A. Dual-chamber pacing in the RA and the infero-base of the RV. B. Biventricular pacing using endocardial leads on the midseptum of the RV and lateral wall of the LV. C. Biventricular pacing using epicardial leads in the infero-base of the RV and lateral wall of the LV.

Conflict of interest

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. None of the authors have any conflicts of interest associated with this study to declare.

Appendix A. Supplementary material

Supplementary data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.joa.2017.07.011.

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