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ADVANCED

CASE REPORT: CLINICAL CASE

Left Bundle Branch Block–Induced Cardiomyopathy in a Transplanted Heart Treated With His Bundle Pacing

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ABSTRACT

A 70-year-old male with prior orthotopic heart transplant developed left bundle branch block followed by new-onset left ventricular systolic dysfunction. He underwent His bundle pacing for cardiac resynchronization therapy with complete normalization of his ejection fraction. This is the first reported case of left bundle branch block–induced cardiomyopathy in a transplanted heart. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2020;2:1932–6) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 70-year-old male with a history of orthotopic heart transplantation (OHT) presented with decompensated heart failure. On examination, heart rate was 117 beats/min and blood pressure was 121/69 mm Hg with no significant murmurs on cardiac auscultation. Chest radiography showed pulmonary edema and brain natriuretic peptide was elevated at 1,480 pg/ml (reference <100 pg/ml). The sirolimus level was therapeutic. Electrocardiogram (ECG) showed sinus tachycardia with a typical left bundle branch block (LBBB) and QRS duration of 170 ms (**Figure 1A**).

MEDICAL HISTORY

The patient had a history of ischemic cardiomyopathy followed by a bicaval OHT 8 years before current

LEARNING OBJECTIVES

- LBBB has not been readily reported in transplant hearts.
- Patients with nonischemic cardiomyopathy and a LBBB have less response to guideline-directed medical therapy compared to those with a narrow complex QRS.
- LBBB-induced cardiomyopathy is a relatively newly described entity in which patients with a LBBB develop LVSD without an alternative etiology, have evidence of mechanical dyssynchrony and subsequent super-response to CRT.
- HBP for CRT is a novel treatment which provides direct correction of the LBBB-induced electrical dyssynchrony compared to conventional BVP. It can be used in non-responders to BVP or as a first-line strategy.
- LBBB-induced cardiomyopathy can occur in transplant hearts.

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presentation. He had undergone annual dobutamine stress echocardiograms with normal left ventricular systolic function and no inducible ischemia. The patient had a baseline narrow QRS on prior routine ECGs.

DIFFERENTIAL DIAGNOSIS

The differential diagnoses for left ventricular systolic dysfunction (LVSD) in a patient with a remote history of OHT include allograft rejection and cardiac allograft vasculopathy. Other causes of cardiomyopathy, such as infiltrative, hypertensive, tachycardia-mediated, idiopathic dilated cardiomyopathy, and LBBB-induced cardiomyopathy must be considered as well.

INVESTIGATION

Transthoracic echocardiogram (TTE) revealed new-onset severely reduced left ventricular ejection fraction (LVEF) of 10% to 15% (**Figure 2A**, Video 1). There was significant intraventricular dyssynchrony with a posterior-to-septal wall delay (PSWD) of 324 ms (**Figure 3A**).

Coronary angiogram showed normal coronary arteries with no transplant vasculopathy. Endomyocardial biopsy revealed mild cellular rejection (1R) with no antibody-mediated rejection. Etiologies of LVSD such as alcohol abuse, illicit drug use, uncontrolled hypertension, and thyroid

ABBREVIATIONS AND ACRONYMS

BVP = biventricular pacing

CRT-D = cardiac resynchronization therapy and defibrillator

HBP = His bundle pacing

LBBB = left bundle branch block

LVEF = left ventricular ejection fraction

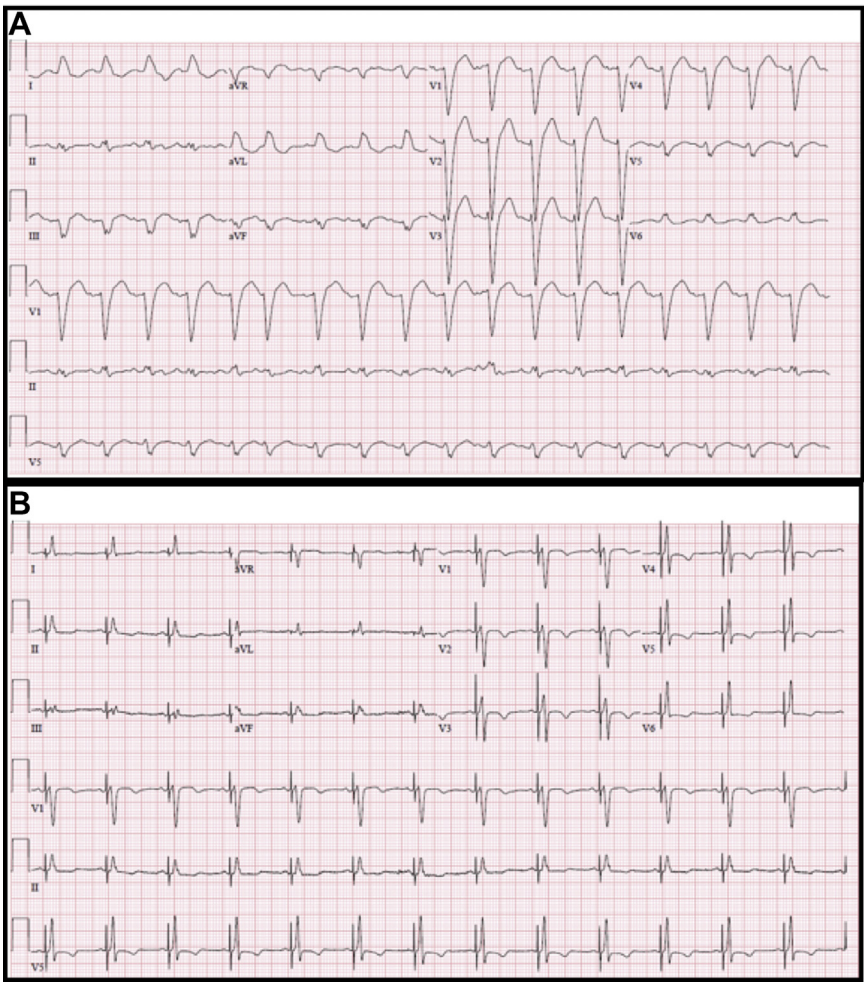
LVSD = left ventricular systolic dysfunction

OHT = orthotopic heart transplant

PSWD = posterior-to-septal wall delay

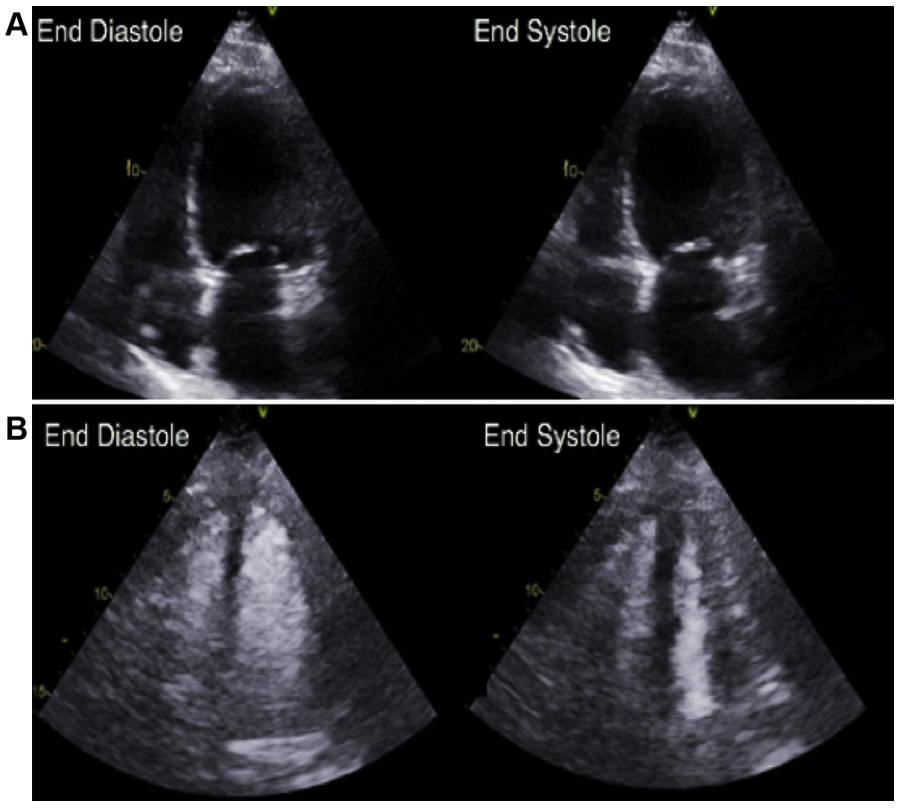
TTE = transthoracic echocardiogram

FIGURE 1 Electrocardiogram



(A) At time of presentation: sinus tachycardia and typical left bundle branch block (LBBB) with a QRS duration of 170 ms. **(B)** After His bundle pacing: nonselective His bundle recruitment of underlying LBBB with a QRS duration of 110 ms.

FIGURE 2 Transthoracic Echocardiogram



(A) At time of presentation: left ventricular dilation and a reduced left ventricular ejection fraction (LVEF) of 10% to 15%. **(B)** Four months after His bundle pacing: reduced left ventricular diameter and normalization of LVEF to 75%.

dysfunction were excluded in this patient. He also had no evidence of atrial tachyarrhythmias on prior ECGs and subsequent device interrogations. Biopsy specimens were negative for infiltrative disease in the donor heart.

MANAGEMENT

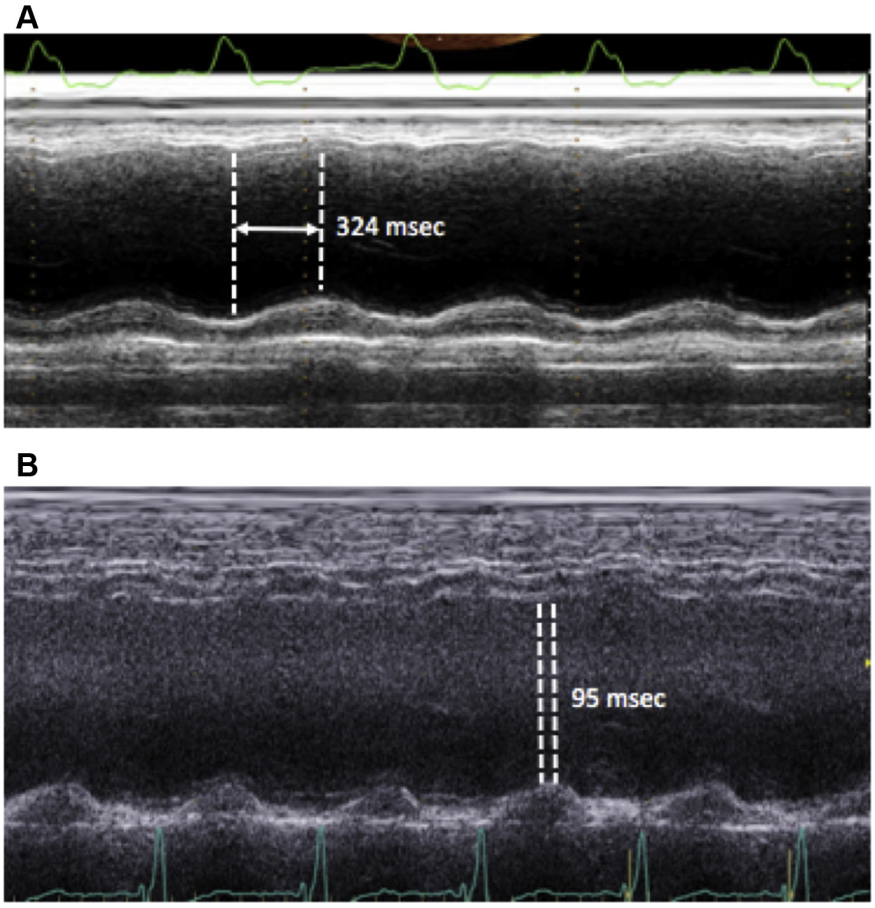
The patient was treated with diuretics as well as high-dose steroids and thymoglobulin for 1R acute cellular rejection in the setting of new-onset LVSD. Repeat endomyocardial biopsy 3 weeks later was negative for cellular rejection (0R). Guideline-directed medical therapy was titrated to maximally tolerated doses. However, repeat TTEs over the following 9 months showed no improvement in LVEF.

The patient was referred to electrophysiology for cardiac resynchronization therapy and defibrillator placement (CRT-D). A review of the patient's serial ECGs showed new-onset persistent typical LBBB 6 months before his presentation with heart failure. Because of the operator's significant experience with His-bundle pacing (HBP), the patient underwent HBP for CRT-D with the SelectSecure pacing lead (model 3830, Medtronic Inc., Minneapolis, Minnesota). The lead was placed in the proximal portion of the His bundle based on HV interval measurements. The His lead was plugged into the left ventricular port of the CRT-D device. Subsequent ECG showed nonselective HBP with recruitment of underlying left bundle branch fibers with a QRS of 110 ms (**Figure 1B**). The pacing threshold for the His lead was 2.25 V at 1 ms and remained stable over time.

DISCUSSION

The most common conduction abnormality after OHT is a right bundle branch block. However, the development of LBBB after OHT has not been readily reported in the literature (1,2). Our patient developed LVSD 6 months after the onset of persistent LBBB. Common etiologies of LVSD were reasonably excluded in this patient and follow-up device interrogation excluded the possibility of subclinical tachyarrhythmias.

FIGURE 3 M-Mode



(A) At time of presentation: intraventricular dyssynchrony with a posterior-to-septal wall delay (PSWD) of 324 ms. **(B)** After His bundle pacing: resolution of intraventricular dyssynchrony with a PSWD of 95 ms.

Although mild cellular rejection cannot be entirely excluded as the cause of late graft failure, the lack of improvement in LVEF with immunosuppression and super-response to His bundle pacing points against this as a cause for his LVSD.

To our knowledge, this is the first reported case of LVSD with LBBB in a transplanted heart treated successfully with HBP with normalization of LVEF. We believe the temporal relationship of new-onset persistent typical LBBB with the development of LVSD, followed by super-response to HBP to be demonstrative of LBBB-induced cardiomyopathy. HBP corrected the underlying LBBB, thereby directly overcoming LBBB-induced electrical dyssynchrony

The concept of LBBB-induced cardiomyopathy has been supported by several studies (3-6). A retrospective study by Valliant et al. (4) defined it as the presence of a typical LBBB for >5 years with normal sinus rhythm and LVEF >50% at the time of diagnosis, with decrease in LVEF to ≤40%, heart failure symptoms, no alternative causes of cardiomyopathy, presence of major left heart mechanical dyssynchrony, and super-response to CRT (10). In this study of 375 patients, 1.6% receiving CRT met these predefined criteria for LBBB-induced cardiomyopathy. While our patient meets most of these criteria, he only developed persistent LBBB 6 months before clinical presentation.

The decision to pursue HBP over conventional biventricular pacing (BVP) for CRT in this patient was based on the operator's experience and positive outcomes with HBP. BVP for CRT has a nonresponse rate of 30% to 40%, which is partially related to unfavorable coronary sinus anatomy (7). Therefore, alternative strategies, such as HBP, have emerged. A previous study has shown the safety and feasibility of

HBP as a bail-out strategy for failed BVP or as an initial strategy for CRT (8). In this study, 75% of nonresponders to BVP had improvement in LVEF after HBP (8). Additionally, the His-SYNC pilot trial was a prospective, randomized controlled trial comparing HBP to BVP as an initial strategy for CRT. While the intention-to-treat study did not show a benefit in HBP compared to BVP, there was considerable crossover. A secondary analysis of the as-treated cohort showed statistically greater electrical resynchronization and a trend toward superior echocardiographic response with HBP compared to BVP (9). Longer trails are required to adequately compare outcomes of these 2 CRT strategies.

FOLLOW-UP

TTE 1-month post-device implantation revealed an improvement in LVEF to 42%. By 4 months, the patient had normalization of LVEF to 75% (**Figure 2B**, Video 2), reduction in PSWD to 95 ms (**Figure 3B**), and significant improvement in exercise capacity and New York Heart Association functional class.

CONCLUSIONS

We demonstrate a case of the development of persistent typical LBBB in a transplanted heart with resultant LVSD, treated successfully with HBP with complete normalization of LVEF. Although LBBB-induced cardiomyopathy is not widely recognized, we believe this case is a unique example of this entity due to the direct correction of LBBB with HBP.

AUTHOR RELATIONSHIP WITH INDUSTRY

Dr. Dandamudi is on the advisory boards of Biotronik, Abbott, and Medtronic; and serves as a consultant for Abbott and Medtronic. All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS cardiac resynchronization therapy, cardiac transplant, cardiomyopathy

APPENDIX For supplemental videos, please see the online version of this paper.