Cryoablation during left ventricular assist device implantation: A case report

Ignoramus et Ignorabimus, Sapere Aude

Erik J. Orozco-Hernandez, MD, a Erwin E. Argueta-Sosa, MD, b Joanna M. Joly, MD, c Salpy V. Pamboukian, MD, MSPH, c Jose A. Tallaj, MD, c and Charles W. Hoopes, MD a

Ignoramus et ignorabimus, sapere aude (We ignore and we’ll ignore, dare yourself to know). A left ventricular assist device (LVAD) is an effective treatment modality for select patients with advanced heart failure (AHF). Ventricular arrhythmias (VAs) are common in the preoperative period with an incidence ranging from 22% to 52%.1 Although patients can tolerate VA in the short-term after LVAD implantation, VAs are associated with increased morbidity, mortality, and length of stay.2,3 There is no standardized strategy for managing these patients.

Case reports of cryoablation during LVAD implant surgery have controversial results.3-5 This procedure is based on the premise that the epicardium and endocardial surface can be visualized. We present a patient with AHF with nonischemic cardiomyopathy and ventricular tachycardia (VT), refractory to conventional therapy, who received a HeartMate 3 (Abbott, Chicago, Ill) LVAD and simultaneous endomyocardial cryoablation.

CENTRAL MESSAGE

Endomyocardial cryoablation during an LVAD implant is an option for patients with end-stage heart failure who have refractory VT. More studies are needed to evaluate this strategy.

JTCVS Techniques 2020;1:55-7

2666-2507

Copyright © 2020 by the American Association for Thoracic Surgery. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/), https://doi.org/10.1016/j.xjtc.2020.01.020

Arrested heart endocardial cryoablation through an apical ventriculotomy before LVAD.

CASE REPORT

A 71-year-old white man with AHF, biventricular implantable cardioverter defibrillator, and recurrent monomorphic VT with 2 radiofrequency ablations within 12 months was referred for advanced therapy consideration. A nuclear stress test demonstrated significant inferoapical scaring. Previous electrophysiologic mapping suggested scar-mediated VT involving the basal wall of the left ventricle (LV). Despite ablation and medical therapy, he had multiple readmissions decompensated with VT.

With the patient’s declining functional status, home intravenous dobutamine was initiated. This improved his functional status, but antitachycardia pacing episodes and implantable cardioverter defibrillator shocks leading to hospital admissions persisted.

Echocardiography revealed a dilated LV, ejection fraction less than 20%, and decreased right ventricular function. Right heart catheterization revealed a right atrial pressure of 19 mm Hg, right ventricle pressure of 50/13 mm Hg, pulmonary artery pressure of 50/30 mm Hg, wedge pressure of 35 mm Hg, and cardiac index of 1.37. Creatinine was 1.7 mg/dL. An intra-aortic balloon pump was placed as a bridge to advanced therapy candidacy. In 1 week, hemodynamics improved with inotropes, intra-aortic balloon pump, amiodarone, sotalol, lidocaine, and diuretics. VT decreased, and renal function normalized.

The patient was categorized as INTERMACS 2, and he underwent HeartMate 3 implant. On full cardiopulmonary bypass, the patient’s aorta was crossclamped, and cardioplegic solution was administered. Apical ventriculotomy was performed with the coring device. We performed endocardial cryoablation on the arrested heart so visualization could be maximized, which allows detailed,
precise, complete and constant myocardial contact (Figures 1 and 2). To prevent reentry circuits, we created a surrounding ablation tract to fixed anatomic sites, that is, the mitral valve. No intraoperative or postoperative electrophysiologic mapping was performed.

After cryoablation, the aortic clamp was released and LVAD implantation was completed. After cardiopulmonary bypass weaning, intraoperative transesophageal echocardiogram showed right ventricular dilatation with poor LVAD filling. Right ventricular mechanical support with the CentriMag (Abbott) was initiated via percutaneous venous femoral access and direct pulmonary artery cannulation. Three days later, this was transitioned to a ProtekDuo cannula (TandemLife, Pittsburgh, Pa) via the right internal jugular vein. The patient had a VT episode in the early postoperative period that was treated successfully with defibrillation and intravenous lidocaine and amiodarone.

Ventricular ectopy decreased during the first 72 hours after surgery. Right ventricular support was removed after 11 days. His subsequent hospital stay was notable for ileus, urinary retention, and physical deconditioning. He was discharged to inpatient rehabilitation. Five months after implant, he remains in New York Heart Association Class I, without VT or implantable cardioverter defibrillator shocks.

**DISCUSSION**

Dor and colleagues reported cryoablation and LV reconstruction in 1994 with optimal results. Other groups, following myocardial scar resection principles and endomyocardial and epicardial cryoablation, achieved arrhythmia resolution with ventricular reconstruction. Even when myocardial scar is not resected, ventricular decompression in conjunction with cryoablation may be effective.

To our knowledge, this case is the first in which endomyocardial cryoablation was performed before HeartMate 3 implant. Criteria to select patients who may benefit from this procedure are not known, but it is well established that risk of VT recurrence is highest in those with VT before LVAD implant. Reports describe this approach with the HeartMate II (Abbott) LVAD implantation. The patient presented could represent a select case in whom ablation provides an additional tool for arrhythmia reduction, similar to previous studies. One potential complication is LVAD thrombosis after endomyocardial cryoablation. As a result, some authors advise limiting to epicardial surface ablations.

Right ventricular failure developed in our patient, which was not unexpected because he exhibited preoperative risk factors for this complication. In addition, because of...
interventricular interdependence, there is a possibility that the septal cryoablation extent may have contributed. There is the theoretical possibility that our patient’s VT burden would be alleviated by adequate LV unloading alone, obviating the need for cryoablation. However, we do not believe our patient’s VT was purely hemodynamically mediated. Although ectopy improved preoperatively, it did not completely resolve.

CONCLUSIONS
Cryoablation during LVAD implantation as a combined procedure is a feasible approach to manage refractory VT in patients with AHF. Additional studies to refine patient selection are needed.

References
1. Bedi M, Kormos R, Winowich S, McNamara DM, Mathier MA, Murali S. Ventricular arrhythmias during left ventricular assist device support. Ann J Cardiol. 2007;99:1151-3.
2. Refaat M, Chemaly E, Lebeche D, Gwathmey JK, Hajar RJ. Ventricular arrhythmias after left ventricular assist device implantation. Pacing Clin Electrophysiol. 2008;31:1246-52.
3. Mulloy DP, Bhambidipati CM, Stone ML, Ailawadi G, Bergin JD, Mahapatra S, et al. Cryoablation during left ventricular assist device implantation reduces postoperative ventricular tachyarrhythmias. J Thorac Cardiovasc Surg. 2013;145:1207-13.
4. Emamnia A, Naggi AS, Ailawadi G, Bergin JD, Kern JA. Concomitant left ventricular assist device placement and cryoablation for treatment of ventricular tachyarrhythmias associated with heart failure. Ann Thorac Surg. 2011;92:334-6.
5. Mcllvennan CK, Magid KH, Ambadarkar AV, Thompson JS, Matlock DD, Allen LA. Clinical outcomes following continuous-flow left ventricular assist device: a systematic review. Circ Heart Fail. 2014;7:1003-13.
6. Dor V, Sabatier M, Montiglio F, Rossi P, Tosso A, Di Donato M. Results of non-guided subtotal endocardectomy associated with left ventricular reconstruction in patients with ischemic ventricular arrhythmias. J Thorac Cardiovasc Surg. 1994;107:1301-7.
7. Sartipy U, Albuge A, Lindblom D. The Dor procedure for left ventricular reconstruction. Ten-year clinical experience. Eur J Cardiothorac Surg. 2005;27:1005-10.
8. DiDonato M, Sabatier M, Dor V. The RESTORE group. Surgical ventricular restoration in patients with post-infarction coronary disease: effectiveness on spontaneous and inducible ventricular tachycardia. Semin Thorac Cardiovasc Surg. 2001;13:480-5.
9. Oswald H, Klein G, Stuber M, Gardiwal A. Implantable defibrillator with left ventricular assist device compatibility. Interact Cardiovasc Thorac Surg. 2009; 8:579-80.