Dramatic Bridge to Bridge Response Using the Impella 5.0 Device: The Importance of Simultaneous Imaging and Hemodynamic Assessment

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Abstract

Percutaneous left ventricular assist devices are approved for cardiogenic shock, but there has been increasing interest in utilizing these devices for hemodynamic support as bridge to durable mechanical circulatory support (MCS). A 63 year-old male with severe ischemic cardiomyopathy was evaluated for MCS. Given severe MR at baseline, it was felt that the Impella 5.0 device would offer the best hemodynamic optimization. Transesophageal echocardiography (TEE) showed severely enlarged left ventricle (78mm) and severe MR (effective regurgitant orifice (ERO) of 0.65cm² and regurgitant volume (RV) of 94ml). After introduction of an Impella with TEE demonstrating correct placement, mean wedge pressure fell to 11 mmHg, lacking prominent V-waves. The severity of MR decreased to mild-moderate (ERO 0.17cm² and RV 30 ml). He underwent LVAD implant after five days of support. This case highlights the acute hemodynamic improvements observed after implantation of an Impella 5.0 in a patient with severe ischemic cardiomyopathy and functional mitral regurgitation, illustrating the benefit of percutaneous devices as bridge to durable MCS, especially in the setting of coexistent valvular disease.

Introduction

Percutaneous left ventricular assist devices are increasingly being considered as a bridge to durable therapy in the setting of decompensated heart failure. The Impella 5.0 (ABIOMED, Inc., Danvers, MA) has recently been introduced, and two main scenarios are emerging for its use in advanced heart failure: (i) refractory cardiogenic shock, for which the Impella carries an FDA indication, and (ii) optimization prior to durable mechanical circulatory support (MCS) or heart transplant, although evidence of benefit in the latter scenario is lacking [1]. We demonstrate the acute hemodynamic effects of Impella 5.0 ventricular unloading in a patient with severe ischemic cardiomyopathy and mitral regurgitation (MR) prior to left ventricular assist device (LVAD) implantation.

Case Presentation

A 63 year-old male with ischemic cardiomyopathy and NYHA class IV symptoms despite optimal medical therapy was evaluated at our institution. A recent right heart catheterization documented pulmonary vascular resistance of 4.5 Woods units and transpulmonary gradient of 21 mmHg, raising concern about listing for transplantation. In the setting of severe MR along with a high pulmonary vascular re-

sistance (PVR), percutaneous mechanical left ventricular unloading was felt to be the most viable path towards successful surgical implantation of a durable MCS device.

The patient was brought to the catheterization laboratory. At baseline, mean RA pressure was 9mmHg, mean PA pressure was 34 mmHg, and mean PCW pressure was 24 mmHg with V-waves to 34mmHg at end-expiration (Figure 1). Simultaneously, transesophageal echocardiography (TEE) was performed to guide Impella placement. Baseline TEE showed severely enlarged LV (left ventricular end-diastolic diameter (LVEDD) 78mm) with estimated ejection fraction of 20%.

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There was a dilated MV annulus and severe MR (proximal isovelocity surface area (PISA)-derived effective regurgitant orifice (ERO) of 0.65cm² and RV of 94ml with systolic reversals (Figure 2 and Video 1)).

Figure 1: Hemodynamic tracings during right heart catheterization during implantation of an Impella 5.0. In all cases, peripheral arterial tracing and ECG are shown. Top left: Pulmonary artery tracing displaying mild baseline pulmonary hypertension (50/24/34 mmHg). Bottom left: Pulmonary capillary wedge tracing showing severe pulmonary wedge hypertension with a mean pressure of 24 mmHg and markedly elevated V-waves to 34 mmHg at end-expiration (white arrows). Top right: Pulmonary artery tracing after implant showing normalized pulmonary hemodynamics (36/16/22). Bottom right: Pulmonary capillary wedge tracing after implant showing normalized pulmonary wedge pressures including resolution of large V-waves and a mean pressure of 11 mmHg at end-expiration.

Figure 2: Transesophageal echocardiographic findings before and on Impella support with regard to mitral regurgitation. Top left: Mid-esophageal view showing left ventricular enlargement (LVEDD 78mm) and mitral valve tenting. Top middle: Mid-esophageal view showing the initial color-flow imaging of the mitral regurgitation and aliasing throughout the left atrium. Pulmonary vein systolic reversal of flow was observed (not shown). Top right: Pre-implant Doppler profile of the mitral regurgitation showing dense signal. Bottom left: Three-dimensional long-axis view of the distal portion of the Impella device, just proximal to the pigtail, visualized crossing the aortic valve. Middle, bottom: Repeat mid-esophageal view with color-flow imaging showing the marked decrease in mitral regurgitation after implant. Bottom right: Doppler profile on Impella therapy showing reduction in density of the signal.

Through a subclavian artery access with a tunneled chimney graft, an Impella 5.0 was introduced into the left ventricle, and fluoroscopy and TEE demonstrated correct Impella placement of the inflow and outflow ports (Video 2). Upon uptitration of motor speed to P9 (5L/min), an immediate decrease in mean PA pressure to 22mmHg and decrease in mean PCW pressure to 11 mmHg, notably lacking prominent V-waves was observed (Figure 1). On Impella support, LV dimensions decreased (LVEDD 65mm from 78). The severity of MR significantly decreased, from severe to mild-moderate, with PISA ERO 0.17cm² and RV 30 ml (Figure 2 and Video 3). He underwent placement of an LVAD after five days of Impella 5.0 support.

Discussion/Conclusion

This case highlights the acute hemodynamic improvements observed after implantation of an Impella 5.0 in a patient with end-stage ischemic cardiomyopathy and severe functional mitral regurgitation with demonstration of a significant reduction in PCW pressure and resolution of prominent V-waves on PCW tracing correlating with improvement of MR severity on TEE.

The use of percutaneous MCS devices for this indication is expanding [2]. While the Impella 5.0 is indicated for refractory cardiogenic shock, [1,3] there has been increasing use of this device as bridge to LVAD [4]. Future studies should examine the short-term effects of unloading with this device in relation to outcomes after definitive therapy is instituted.

Conflict Of Interest (COI)

The authors declare that there are no conflicts of interest.

References:

1. Griffith BP, Anderson MB, Samuels LE, Pae WE, Naka Y, et al. (2013) The RECOVER I: A multicenter prospective study of Impella 5.0/LD for postcardiotomy circulatory support. *J Thorac Cardiovasc Surg* 145: 548-554. [[Crossref](#)]
2. Brown JL, Estep JD (2016) Temporary Percutaneous Mechanical Circulatory Support in Advanced Heart Failure. *Heart Fail Clin* 12: 385-398. [[Crossref](#)]
3. Gaudard P, Mourad M, Eliet J, Zeroual N, Culas G, et al. (2015) Management and outcome of patients supported with Impella 5.0 for refractory cardiogenic shock. *Crit Care* 19: 363. [[Crossref](#)]
4. Lima B, Kale P, Gonzalez-Stawinski GV, Kuiper JJ, Carey S, et al. (2016) Effectiveness and safety of the impella 5.0 as a bridge to cardiac transplantation or durable left ventricular assist device. *Am J Cardiol* 117: 1622-1688. [[Crossref](#)]