Case Reports

Successful Use of Surgically Placed Impella 5.0

and Central Extracorporeal Membrane Oxygenation Circuit in a Patient with Postcardiotomy Shock

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The Impella 5.0, a percutaneously inserted left ventricular assist device, has been used to support patients who have severe heart failure or who are undergoing high-risk percutaneous coronary intervention. We report our surgical placement of the Impella 5.0, through a graft sewn to the aorta, to unload the left ventricle of a 59-year-old man who was undergoing venoarterial extracorporeal membrane oxygenation for postcardiotomy shock. The patient underwent successful placement of a long-term left ventricular assist device before his discharge from the hospital. The versatility of the Impella 5.0 is exemplified in this patient who was successfully bridged to long-term support. ***(Tex Heart Inst J 2015;42(6):569-71)***

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Venoarterial extracorporeal membrane oxygenation (VA ECMO) is a valuable rescue technique for patients with refractory cardiogenic shock.[1] Even in the presence of nearly complete cardiopulmonary bypass (CPB) during VA ECMO, some blood will return to the left ventricle (LV). Unlike traditional LV assist device (LVAD) support, VA ECMO pressurizes the systemic arterial circuit without directly unloading the left side of the heart. As a result, the failing LV might not have sufficient contractility to open the aortic valve. This causes progressive LV distention, which impairs myocardial recovery and can lead to pulmonary edema, pulmonary hemorrhage, or LV thrombus formation.[2,3] Several approaches to LV decompression have been successfully used, including atrial septostomy, percutaneous placement of a pulmonary artery drainage catheter, intra-aortic balloon pumps (IABPs), percutaneous or direct placement of LV vents, and percutaneously placed microaxial pumps.[4,5]

The Impella® 5.0 (ABIOMED, Inc.; Danvers, Mass) is a percutaneous LVAD that is positioned across the aortic valve with inflow in the LV and outflow in the ascending aorta. This configuration augments forward flow and directly decompresses the LV. The Impella family of devices has been used for postcardiotomy circulatory support, cardiac support during high-risk percutaneous coronary intervention, treating cardiogenic shock after myocardial infarction, and treating viral myocarditis.[6] The devices have also been successfully used for LV decompression after percutaneous placement during peripheral VA ECMO.[7] We report our direct aortic placement of the Impella 5.0 in conjunction with centrally cannulated VA ECMO.

Case Report

In July 2014, a 59-year-old man with a history of myocardial infarction, stroke, hypertension, and hyperlipidemia was seen for angina by his cardiologist. Myocardial infarction was ruled out, and results of cardiac catheterization revealed 3-vessel coronary artery disease. Echocardiograms showed an LV ejection fraction of 0.45 and no substantial valvular disease. At our hospital, the patient underwent 3-vessel off-pump coronary artery bypass grafting. The target vessels were of poor quality, and the operation was complicated by graft occlusion that necessitated thrombectomy of venous grafts to the ramus intermedius and posterior descending coronary artery, and IABP placement. Flow in the left internal mammary artery graft to the left anterior descending coronary artery was low because of poor runoff. In the intensive care unit (ICU), the patient needed support with dobutamine, vasopressin, norepinephrine, and epinephrine.

The patient's hemodynamic status worsened on postoperative day (POD) 3. An electrocardiogram showed a paced rhythm that precluded interpretation of the ST segments, and the patient's cardiac troponin level was elevated. He was returned to the operating room for evaluation of his grafts and possible mechanical circulatory assistance. He sustained a cardiac arrest upon induction of anesthesia, prompting emergent reopening of the chest and internal cardiac massage followed by initiation of CPB. Extensive LV infarction was noted, and graft thrombectomy was again performed on both venous grafts. The CPB cannulas were transferred to a CARDIOHELP ECMO circuit (MAQUET Cardiovascular, LLC; Wayne, NJ), the IABP was left in place, and the patient was returned to the ICU.

In the ICU, the ECMO flow was maintained from 4 to 4.5 L/min. The patient's blood pressure, urine output, and peripheral perfusion remained acceptable as he was weaned from vasopressors and inotropic agents. On POD 5, pink frothy secretions exuded from the patient's endotracheal tube in conjunction with increasing central venous and pulmonary artery pressures.

On POD 6, the patient underwent surgical placement of an Impella 5.0 LVAD. Initial transesophageal echocardiography (TEE) revealed a distended LV with severely depressed systolic function (LVEF, <0.10). A 10-mm Dacron graft was sewn to the ascending aorta, and the Impella was placed through this graft into the aorta (Fig. 1). Repeat TEE confirmed correct placement across the aortic valve and adequate LV decompression (Fig. 2). The patient's hemodynamic values became normal and his pulmonary edema resolved, enabling us to remove the VA ECMO circuit and to continue Impella support on POD 8. After the cessation of ECMO, the patient's right-sided heart function was adequate on minimal support. The Impella device was removed, and a HeartMate II® Left Ventricular Assist System (Thoratec Corporation; Pleasanton, Calif) was inserted on POD 13. The patient underwent 2 subsequent mediastinal washouts, and his chest was closed on POD 16. He was weaned from all vasoactive agents and mechanical ventilation and was transferred to a long-term acute care hospital.

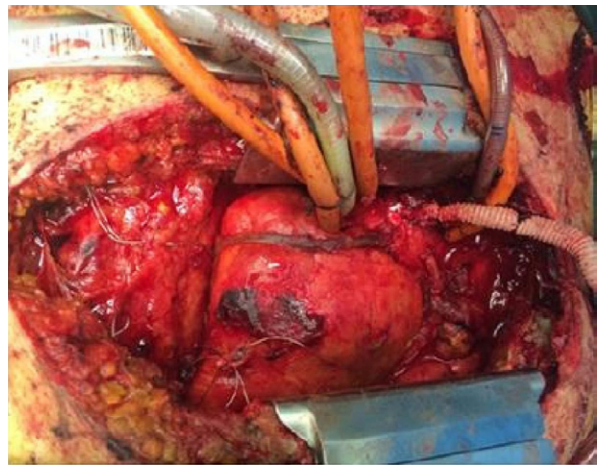

Fig. 1 *Intraoperative photograph shows the 10-mm Dacron graft through which the Impella 5.0 device was placed into the ascending aorta.*

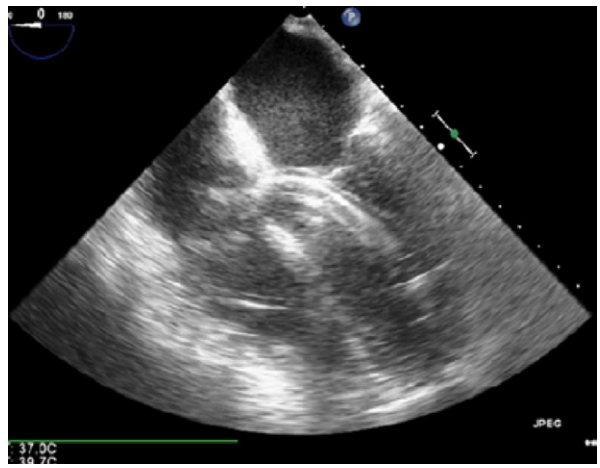

Fig. 2 *Transesophageal echocardiogram shows correct placement of the Impella device and consequent left ventricular decompression.*

Discussion

In multiple situations, including postcardiotomy LV failure, VA ECMO has provided adequate end-organ perfusion for patients who are in cardiogenic shock. However, the imposed afterload and lack of LV decompression causes progressive distention that impairs recovery and might preclude subsequent transplantation or transition to long-term mechanical circulatory support.

An IABP is often placed to increase LV ejection by decreasing afterload. In our experience, this is often inadequate in patients who are supported by VA ECMO. Atrial septostomy decreases LV distention by decreasing venous return; however, it does not prevent stasis or LV thrombus formation. Furthermore, atrial septal repair would be necessary before transition to a long-term LVAD. The direct placement of LV vents deals with the short-term concerns of LV distention and stasis but does not provide a means of LV support after ECMO is removed.

The Impella 5.0 can effectively decompress the LV, whether by percutaneous or direct surgical insertion.[7] Our experience is consistent with other authors' observations that the device helps to directly unload the LV during VA ECMO support.[8] In addition, Impella use can be continued for full hemodynamic support after the central ECMO circuit is removed. This provides valuable time to evaluate the patient's potential for re-

covery or candidacy for transplantation or candidacy for long-term LVAD placement.

The surgical placement of the Impella 5.0 enabled us to treat our patient's postcardiotomy shock at the time of reoperation. Postcardiotomy shock has a high mortality rate, and few options exist for promoting recovery in such profoundly ill patients. The use of a central ECMO circuit and the concomitant placement of an Impella device can help to unload the LV, enable optimal hemodynamic and cardiac recovery, and prevent LV thrombus formation and pulmonary damage. At minimum, Impella use can enable the cessation of central ECMO, provide primary LV support, and serve as a bridge to a more permanent LVAD, as in our patient. The versatility of the Impella 5.0 is exemplified in this patient who was successfully bridged to long-term support.

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