Case Report

Successful Combined Use of Impella Recover 2.5 Device and Intra-Aortic Balloon Pump Support in Cardiogenic Shock from Acute Myocardial Infarction

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Ventricular assist devices (VADs) and intra-aortic balloon pumps (IABPs) are important tools that provide hemodynamic support to patients in cardiogenic shock. The Impella Recover 2.5 is a percutaneous VAD that provides temporary circulatory support. We report the case of a patient who required the combined support of both an IABP and the Impella device. ASAIO Journal 2010; 56:519–521.

Cardiogenic shock (CS) after an ST-elevation myocardial infarction (STEMI) is a lethal clinical condition, with a reported mortality of 65% in a recent series.1 Although intra-aortic balloon pump (IABP) support may sustain some patients, improvements in cardiac output are quite modest—approximately 0.5 L/min. Ventricular assist devices (VADs) have been the mainstay in patients who require a greater degree of hemodynamic support. Unfortunately, postinfarction and postcardiotomy VAD support carries a relatively high rate of mortality and morbidity.2

Percutaneous VADs, which can be placed in the catheterization laboratory, have recently been approved for the treatment of CS. One such device is the Impella Recover 2.5 (Impella CardioSystems, AG, Aachen, Germany) in which the pump is deployed in a retrograde manner across the aortic valve. The pump is connected to a mobile control console and is capable of providing up to 2.5 L/min of support at its highest operating speed. This device is approved by Food and Drug Administration for partial circulatory support for periods up to 6 hours under a 510(k) exemption.

A recent animal study published by Sauren et al.3 suggests that combined use of the Impella Recover 2.5 and an IABP may provide synergistic support. Herein, we report the case of a patient with an STEMI complicated by medically refractory cardiogenic shock who underwent successful support with both devices and was successfully discharged home.

CASE PRESENTATION

The patient is a previously healthy 67-year-old woman who presented with an STEMI complicated by CS. Despite conventional pharmacotherapy for CS, the patient remained hemodynamically unstable with a mean arterial pressure (MAP) <50 mm Hg on high-dose vasopressor support. An electrocardiogram indicated an acute anterolateral STEMI and new left bundle branch block; transthoracic echocardiography revealed severe left ventricular dysfunction, with an ejection fraction (EF) of 10%, along with moderate mitral and tricuspid regurgitation. An IABP was percutaneously placed via the right femoral artery, and the patient was brought immediately to the cardiac catheterization laboratory.

Cardiac catheterization showed an 80% proximal left anterior descending artery (LAD) lesion, a 95% mid-LAD stenosis with collateralization, a 100% mid-circumflex stenosis (the culprit lesion), and a completely occluded second obtuse marginal. Bare metal stents were placed in the proximal left circumflex artery, proximal left anterior descending artery, and the second obtuse marginal artery. Because of persistent shock despite revascularization and IABP support, an Impella Recover 2.5 was percutaneously placed via the left femoral artery. The logistics of the Impella insertion were as follows: the IABP was placed in “Pause” mode; the Impella was then inserted via the left femoral artery. Impella flow was titrated up to maximal support (2.5 L/min) to achieve a total cardiac output of >4 L/min. Because the patient’s MAP remained low even after Impella actuation, the IABP was reactivated.

Table 1. Hemodynamics During Coronary Angiography Clearly Demonstrate Marked Improvement with Combined Impella Recover 2.5 and IABP Support

<table>
<thead>
<tr>
<th></th>
<th>IABP Alone</th>
<th>Impella Recover 2.5 Alone</th>
<th>Combined IABP and Impella Recover 2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Systolic blood pressure (mm Hg)</td>
<td>114</td>
<td>85</td>
<td>107</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm Hg)</td>
<td>36</td>
<td>56</td>
<td>79</td>
</tr>
<tr>
<td>Mean arterial pressure (mm Hg)</td>
<td>62</td>
<td>66</td>
<td>88</td>
</tr>
<tr>
<td>Heart rate (beats per minute)</td>
<td>105</td>
<td>110</td>
<td>108</td>
</tr>
<tr>
<td>Arterial oxygen saturation (%)</td>
<td>95</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

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Submitted for consideration July 2010; accepted for publication in revised form August 2010.

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DOI: 10.1097/MAT.0b013e3181f7478e
The resultant MAP with both devices functioning was 10–20 mm Hg higher than with either device alone (Table 1). In addition, the mixed venous oxygen saturation increased from 54% with IABP alone to 75% with both devices in place. Figure 1 shows a chest x-ray demonstrating the Impella Recover 2.5 LVAD and IABP in position. Figure 2 depicts the patient’s cardiac index and mixed venous saturations during the ensuing hospital course.

Because of the initial hemodynamic insult, the patient progressed to multisystem end-organ failure (MSOF) requiring continuous veno-venous hemodialysis and prolonged ventilatory support. After 6 days of support, the Impella Recover 2.5 device was removed, followed by removal of the IABP 4 days later. Continued recurrent episodes of polymorphic ventricular tachycardia prompted repeat heart catheterization 2 weeks after admission, which demonstrated a dissection of the proximal left main coronary artery that presumably occurred at the time of initial catheterization. This dissection was treated by the successful placement of a drug-eluting stent in the left main coronary artery. Over the ensuing weeks, the patient’s organ systems improved: her liver function tests had normalized, hemodialysis was discontinued, and she was weaned from mechanical ventilation.

Repeat echocardiography 6 weeks after her admission demonstrated an improved EF of 30%. The patient was ultimately discharged to a rehabilitation facility after 2 months of hospitalization and then discharged home 2 weeks later. On follow-up visit 4 months after her STEMI, the patient was in New York Heart Association (NYHA) class III with an EF of 30%. She underwent cardiac resynchronization therapy and implantable cardioverter defibrillator placement because of persistent left bundle branch block and left ventricular dysfunction. At 16 months after her initial presentation, the patient has improved to NYHA class II and is living independently.

Discussion

Cardiogenic shock is the most common mode of in-hospital death in patients after acute myocardial infarction. Early revascularization with thrombolytic therapy, percutaneous transluminal coronary angioplasty, or coronary artery bypass grafting has been proven to reduce in-hospital mortality.

IABP insertion is usually the initial means of stabilizing the patient. LVADs have been used to provide hemodynamic support and act as a bridge to either recovery or heart transplantation.

Although little has been reported of the successful combined use of the Impella Recover 2.5 LVAD and IABP in the setting of CS due to myocardial infarction, the results of animal studies have been encouraging. Sauren et al. induced acute myocardial infarction in seven sheep. Hemodynamic support was
provided with the Impella Recover 2.5 device alone, IABP alone, and then with both combined. While each modality individually improved the hemodynamic profile, a synergistic effect of combined Impella Recover 2.5 LVAD and IABP was observed. The concomitant use of both devices resulted in a lower left-ventricular end-diastolic pressure (LVEDP) as well as lower afterload than either device alone. The combination also had a synergistic effect on improving systemic, carotid, and coronary artery perfusion as well as decreasing myocardial work and oxygen demand.3

There are two published case reports of patients in whom both the Impella Recover 2.5 LVAD and IABP were used together.5,6 In one report, the patient died of progressive MSOF the day after insertion. However, the case did confirm the laboratory findings of Sauren et al.3: combined use resulted in increased tissue perfusion than either device alone. The second report detailed the successful combined use of the IABP and Impella in a young woman who suffered a cardiac arrest unrelated to ischemia.6

The patient we report here had a remarkable recovery. Her hemodynamic parameters after insertion of either the IABP or Impella alone were not sufficient to maintain end-organ perfusion. After concomitant activation of both devices, the patient maintained a cardiac index above 2 L/min and an SvO₂ above 70%. This strategy allowed partial recovery of her heart as well as her other organ systems, allowing salvage of a patient who would not likely have survived otherwise.

References