COMMENTARY

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Improving Survival in Cardiogenic Shock: Is Impella the Answer?

Cardiogenic shock complicates approximately 8% of all ST-segment elevation myocardial infarctions and has a dismal prognosis.[1] Even in patients with cardiogenic shock treated with an invasive approach (cardiac catheterization, angioplasty, and coronary bypass surgery), in-hospital mortality approaches 40%.[2] For many years, the intra-aortic balloon pump was thought to be helpful in improving outcomes in cardiogenic shock. However, the landmark randomized, controlled IABP-SHOCK II trial, published in 2012, [3] concluded that the use of intra-aortic balloon counterpulsation did not significantly reduce mortality in patients with cardiogenic shock complicating acute myocardial infarction. This led investigators to search for alternate mechanical circulatory support systems that might prove effective in reducing mortality in cardiogenic shock. One such system is the Impella device (Abiomed, Danvers, Mass).

Impella is a catheter-based miniaturized ventricular assist device. Using a retrograde femoral artery access, it is placed in the left ventricle across the aortic valve. The device pumps blood from the left ventricle into the ascending aorta and systemic circulation at an upper rate between 2.5 and 5.0 L/min. (In contrast, the ability of the intra-aortic balloon pump to augment cardiac output is very modest; no more than 0.5 L/min.[4]) The hemodynamic effects provided by Impella result in almost immediate and sustained unloading of the left ventricle while increasing overall systemic cardiac output. These superior hemodynamic effects of the Impella system, when compared with the intra-aortic balloon pump,[4] have resulted in increasing focus on the Impella system as a possible way of making a dent in the devastating mortality rate associated with cardiogenic shock.[4]

There have been 3 randomized controlled clinical trials comparing the mortality rates of Impella and the intra-aortic balloon pump in cardiogenic shock.[5-7] However, the numbers of patients enrolled in each of these studies were small. In the largest of these trials (the Impress trial[7]), only 48 patients were studied. No mortality difference was found in any of these trials or, indeed, with meta-analysis of the 3 trials (total of 95 patients),[8] which is not surprising, as the trials were underpowered to detect a mortality difference. Moreover, as the investigators of these trials have noted, randomized controlled trials in the emergency setting of cardiogenic shock are exceptionally difficult to conduct,[5] and it is far from certain whether large-scale randomized trials will ever become reality. However, there has been a large body of nonrandomized clinical data suggesting a potentially useful role for the Impella system in the treatment of cardiogenic shock.[9-12] In the USpella Registry of patients with cardiogenic shock treated with Impella devices before undergoing coronary angioplasty, this mechanical support resulted in improved survival to hospital discharge.[9] In addition, a multicenter, prospective study of the use of the Impella device for the treatment of patients developing cardiogenic shock after cardiac surgery (the RECOVER I trial) reported very favorable results.[10] The primary end points of this study (death or stroke at 30 days) occurred in only 13% of patients. In 2016, on the basis of analysis of the finding of this study and of the USpella Registry observations, the US Food and Drug Administration granted approval for use of the Impella device for the treatment of cardiogenic shock complicating acute myocardial infarction.

A recent meta-analysis of emerging trial and registry data has suggested that in patients with cardiogenic shock undergoing angioplasty, a strategy of implanting the Impella device *prior to* performing angioplasty is associated with improved survival when compared with a strategy of initiating Impella support only after completion of angioplasty.[13] In addition, there has been increasing support for the idea of routine Swan-Ganz monitoring during treatment of cardiogenic shock.[4] To determine the feasibility and clinical utility of routinely incorporating these 2 concepts in the treatment of cardiogenic shock, William O'Neill

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formed the Detroit Cardiogenic Shock Initiative.[14] Specifically, 4 sites in the metropolitan Detroit area agreed to treat patients with cardiogenic shock complicating acute myocardial infarction using a mutually agreed upon protocol emphasizing invasive hemodynamic monitoring and rapid initiation of Impella support. Survival to discharge in the 41 patients enrolled in this single-arm study was 76%, a significant improvement from institutional historical control rates of 50%.[14] Given these encouraging results, a national, multicenter, quality initiative entitled the National Cardiogenic Shock Initiative has been launched. Among the metrics that will be tracked in this study is whether survival >80% can be achieved with the strategy developed in the Detroit initiative.[14] It is our expectation that there will soon be widespread adoption of this strategy of early Impella placement in the treatment of patients with cardiogenic shock. In turn, it is hoped that this strategy will result in improved survival.

Currently in the United States, 42% of patients with cardiogenic shock complicating myocardial infarction are treated with an intra-aortic balloon pump, despite a lack of evidence for this treatment in cardiogenic shock.[15] In contrast, only 6% are treated with an Impella device.[16] Although there is an absence of evidence based on randomized clinical trials, a growing body of registry and observational data suggests an important role for the Impella system in the treatment of cardiogenic shock. Accordingly, it would appear reasonable to expect a significant increase over the next few years in the use of the Impella device in the treatment of cardiogenic shock, with a parallel decrease in use of the intra-aortic balloon pump.

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