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Editorial

Is the "Unprotected Heart" a clinical myth? Use of IABP, Impella, and ECMO in the acute cardiac patient

Altering hemodynamics through intravascular mechanical devices has been a major practice change over the past 20 years. The physiologic advantages of these devices are enticing. With intra-aortic balloon pumps (IABP), we can improve coronary perfusion pressures. With Impella (Abiomed, Boston, MA), we can reduce left ventricular distension and lower end-diastolic pressure. With extracorporeal membrane oxygenation (ECMO), we can improve perfusion, oxygenation, and ventilation. Each of these devices comes at a physiologic cost. These costs can potentially outweigh the benefits they provide.

The question in 2019 is who should be receiving these devices? In this edition of Resuscitation, Davidsen et al. share their nearly 10-year experience on Impella use in cardiac arrest and cardiogenic shock.[1] The authors should be commended on their accumulation and synthesis of 92 patients. This data adds to the growing research on outcomes with use of Impella. They found that patients with ongoing CPR did worse than those who obtained return of spontaneous circulation (ROSC). Likewise, ROSC patients did worse than those who did not arrest. Subgroup analysis found hypertension and older age to be predictive of death.

Concluding from this paper that Impella does not work for cardiac arrest would be erroneous. While this still may be true, this data set alone does not prove or disprove this. We can make conjectures about the 6% thirty-day survival from patients with ongoing CPR, but it is difficult to do so without an adequate control group. Given the median time from cardiac arrest to Impella insertion of nearly two hours (1.86 h, all cardiac arrests), a 6% survival may be significantly better than expected, even in a highly advantaged patient cohort.[2] Caution is advised even with this interpretation as this data set includes patients who had ECMO both before and after Impella insertion. Also, a heterogeneous type of Impella insertion (2.5, 5, and CP versions) was used through the study.

This data is hypothesis generating. As stated by the authors, the subgroup analysis of hypertension and older age as negatively predictive has borne out in other data sets. Equally intriguing is ROSC did not confer a statistically significant survival benefit after regression suggesting known problems associated with small data set analysis.

So where does this leave us in appropriate use of mechanical circulatory support in the failing heart? For Impella use in the STEMI patient without shock, the data is sparse. A feasibility trial showed a delay in reperfusion of 25 min when Impella was inserted prior to balloon.[3] A larger trial is underway to see if the advantages of Impella prior to reperfusion makes up for this delay.[4] From a physiologic standpoint, Impella could offer benefit by off-loading the work of the heart during cardiac catheterization.[5] In cardiogenic shock, retrospective and small randomized data on Impella use as compared to intra-aortic balloon pump, medical therapy, or ECMO have not shown benefit.[6–9] In cardiac arrest, a single case series did show promise for Impella as a solo device with a 58% neurologically intact survivorship.[10]

An important caveat is that patients with a STEMI, cardiogenic shock, or cardiac arrest have varied patient dynamics that may benefit from specific devices over others. A heart that is not ejecting is unlikely to benefit from a balloon pump. Likewise a patient on ECMO with normal left ventricular volumes may not benefit from the addition of Impella. These patient characteristics are not appreciated in much of the data. Use of these devices to correct a specific problem may make the most sense until larger randomized trials offer better decision making. Animal data affirms this concept with Impella offering benefit when the unloading of the left ventricle is desired and ECMO if perfusion and/or oxygenation is needed.[11] Caution with universal adoption of Impella is certainly warranted in all three scenarios of STEMI, cardiogenic shock, and cardiac arrest as the data is currently less than compelling.

A common strategy of utilizing Impella in patients who are being treated with venoarterial ECMO may offer benefit. Impella can decrease the left ventricular distension that can lead to increased pulmonary edema, decreased myocardial contractility via increased wall tension, and impair the ultimate goal of weaning. Pappalardo et al. did show a statistically significant mortality benefit with this strategy.[12]

Complications from these strategies must be appreciated. Valve injury, retroperitoneal perforation, hemolysis, and afterload implications can lead to significant patient morbidity. Therefore, thoughtful decisions to initiate any mechanical device and continuous consideration for weaning are imperative.

Davidsen et al.'s work reminds us that we are still exploring the nuances of mechanical circulatory support. Artificially augmented perfusion offers great potential for benefit with each new technological iteration. The specifics of which device, in which patient, in what combination, and for how long is still far from defined.

Conflict of interest

No conflicts of interest.

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