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Reviews:

Left Ventricular Unloading by Impella Device Versus Surgical Vent During Extracorporeal Life Support

Tepper et al. Left Ventricular Unloading by Impella Device Versus Surgical Vent During Extracorporeal Life Support. *Ann Thorac Surg* 2017; 104: 861-7.

Extracorporeal Life Support (ECLS) has been used to support patients in cardiogenic shock for numerous etiologies. It has also been used as a bridge to a more durable left ventricular assist device (LVAD). ECLS is limited; it does not directly unload the left ventricle (LV). The Impella (Abiomed, Danvers, MA) percutaneous ventricular assist device (PVAD) was approved by the Food and Drug Administration (FDA) for the treatment of cardiogenic shock. The purpose of this study was to examine the efficacy of the percutaneous ventricular assist device (PVAD) in unloading the left ventricle (LV) during extracorporeal life support (ECLS), and, to compare the outcomes and the complications of PVAD with a surgically inserted LV vent.

Tepper et al conducted a retrospective single institution study. All patients supported with ECLS and PVAD or with ECLS and a surgical LV vent for cardiogenic shock from April 2010 to May 2016 were included.

PVAD was an Impella microaxial pump inserted percutaneously in to the femoral artery or surgically in the axillary artery. ECLS is a centrifugal pump with an adult microporous membrane oxygenator. Peripheral ECLS was through the femoral artery and the vein cannulation. Central ECLS was through the aorta and right atrium. Distal perfusion cannulas were used for the superficial femoral artery. Surgical vents were placed through the LV apex, right superior pulmonary vein or the pulmonary artery and then combined with the ECLS venous drainage.

The primary outcomes of the study were survival at 48 hours and 30 days after combined support initiation and to ICU discharge. A secondary outcome was ECLS decannulation, transition to LVAD and vascular complications. Complications included: bleeding, circuit-related hemolysis, hypoperfusion or limb ischemia at cannulation site.

The results found forty-five patients (45) at a single institution were supported by ECLS for cardiogenic shock with simultaneous PVAD or surgical LV vent. The age ranged from 52-65 years (median 58 years) for a PVAD. The age ranged from 46-63 years (median 56 years) for a surgical LV vent. 74% of the patients in the PVAD group were men and 59% in the surgical LV vent group. Table 1 outlined the patient demographics and baseline and the only value of statistical significance was hyperlipidemia in the ECLS+LV vent group ($p=0.004$). Table 2 noted procedural characteristics. Of note, more surgical vent patients received support for post-cardiotomy shock. More PVAD patients received support for

acute myocardial infarction. Central ECLS was used in 91% of the patients with a surgical vent and 30% of PVAD patients. Peripheral ECLS was used in 70% of PVAD patients and 9% of surgical vent patients. The surgical vent was placed through the LV apex in 10 patients, left atrium in 9 patients and pulmonary artery in 3 patients. Table 3 reviewed hemodynamics after 48 hours of support. The central venous pressure ($p=0.02$), AST ($p=0.004$) and ALT ($p=0.002$) were significantly reduced in the PVAD group at 48 hours. The pulmonary artery diastolic pressure was significantly reduced in both groups at 48 hours (PVAD $p=0.02$ and surgical vent $p=0.01$). Cardiac function recovered in 39% of PVAD patients and 27% of surgical vent patients. Table 4 summarized the patient outcomes and complications. The primary outcome of survival at 48 hours 87% for PVAD and 95% for surgical vent ($p=0.61$), 30 day discharge 43% PVAD vs 32% surgical vent ($p=0.42$), and ICU discharge 35% PVAD vs 23% surgical vent ($p=0.37$).

In conclusion, the PVAD was an effective means of unloading the LV during ECLS support. The reduced AST and ALT demonstrated in patients after 48 hours in the ICU with PVAD and ECLS may indicate the combination had a greater improvement on perfusion capability. The PVAD is comparable to a surgical vent for unloading the LV. The PVAD is less invasive and can be inserted percutaneously.

Importance of Stratifying acute kidney injury in cardiogenic shock resuscitated with mechanical circulatory support therapy.

Abadeer et al. Importance of stratifying acute kidney injury in cardiogenic shock resuscitated with mechanical circulatory support therapy. *J Thorac Cardiovasc Surg* 2017; 154: 856-64.

Outcomes for short-term mechanical circulatory support (ST-MCS) are poor. Despite these poor outcomes, the use of ST-MCS is ever present and continues to grow. Acute kidney injury (AKI) is often a complication of cardiogenic shock. This study evaluated the incidence of Acute Kidney Injury (AKI) in patients on Short Term Mechanical Circulatory Support (ST-MCS).

Abadeer et al conducted a single institutional retrospective study. Refractory cardiogenic shock was defined as a systolic blood pressure less than 90 mmHg, a cardiac index of less than 2.0L/min/m², evidence of end organ dysfunction in the setting of pharmacotherapy and an intra-aortic balloon pump. These patients were evaluated for ST-MCS; either ECMO or ST-Ventricular assist device (VAD). Within this institution, ECMO is used primarily for patients in whom the neurological status is unknown, too unstable for transport or those with severe coagulopathy. For patients with ST-MCS and acute kidney dysfunction, the nephrology service is consulted for renal replacement therapy (RRT).

There were 293 consecutive patients between 2007-2013 with refractory cardiogenic shock who had either an ST-VAD or ECMO. The following patients were excluded: pre-existing end stage renal disease, incomplete data to stage AKI, or if RRT had been started more than 1 day prior to device insertion or ECMO cannulation.

The primary outcomes evaluated was postoperative AKI; and, the secondary outcome was longterm mortality.

Two hundred ninety-three patients were eligible for inclusion and received mechanical circulatory support for cardiogenic shock. 163 patients were placed on ECMO and 130 were placed on VADs. The cause of the cardiogenic shock included post-cardiotomy shock in 90 patients (30.7%), acute MI in 79 patients (27%), acute decompensated heart failure in 51 patients (17.4%) and transplant graft dysfunction in 36 patients (12.3%). 177 patients (60.4%) experienced AKI; 40 (13.7%) stage 1, 24 (8.2%) Stage 2, or 113 (38.6%) stage 3 (severe). 116 (39.6%) did not experience AKI. The severe AKI patients were often on ECMO for short term MCS ($p=0.27$). 131 patients (44.7%) required renal replacement therapy (RRT) during their hospitalization. The average age of patients on RRT was 56.2±15.4 years. Of those who survived, 11 (8.4%) patients required hemodialysis on discharge.

Of the 177 patients who experienced AKI, 72 (40.7%) survived to hospital discharge. 52 of the 72 patients (72.2%) experienced renal recovery. Patients who had severe AKI who survived to discharge with renal recovery (24 patients) had a mean recovery time of 24.5 days. Those with stage 1 or 2 AKI recovered on average of 5.6 days. Eleven patients (15.3%) required hemodialysis on discharge and 9 patients had some form persistent kidney injury after discharge with persistently elevated creatinine.

In-hospital mortality of overall cohort was 53.9%; 66.4% in the severe AKI and 46.1% in the non-severe AKI ($p < 0.001$). Five patients in the severe AKI group received a durable VAD compared to 30 patients in the non-severe AKI group (17.1%; $p = 0.002$). One year survival was 49.2% in the non-severe AKI group and 27.3% in the severe AKI ($p < 0.00$). Multivariate Cox regression analysis demonstrated severe AKI, age and device type to be a significant predictors of long-term mortality.

In conclusion, 40% of patients were free from any AKI. A history of CVA and pre-operative creatinine were independent predictors of developing severe AKI. Time to recovery differed significantly between severe and non-severe AKI. Severe AKI resulted in higher in-hospital mortality (>60%) and a lower 1 year survival (27%). Severe AKI was a predictor of late mortality.