Left ventricular unloading during extracorporeal life support (ECLS) by percutaneous ventricular assist device (PVAD) therapy in patients with severe cardiogenic shock

A Supady^{1,2}, T Wengenmayer^{1,2}, C Bode^{1,2}, DL Staudacher^{1,2}

¹Department of Medicine III (Interdisciplinary Medical Intensive Care), Medical Center, University of Freiburg, Faculty of Medicine, University of Freiburg, Germany; ²Department of Cardiology and Angiology I, University Heart Center Freiburg University, Germany

Background/Introduction: In patients with extracorporeal life support (ECLS) in cardiogenic shock, increased left ventricular afterload might reduce left ventricular ejection fraction and lead to pulmonary congestion. Percutaneous ventricular assist devices (PVAD) like the Impella® device (Abiomed, Danvers, MA) can be used for left ventricular (LV) unloading and might reduce afterload in ECLS patients.

Aim of the study was to examine feasibility of concomitant ECLS and PVAD therapy in patients in cardiogenic shock. Secondary aim of the study was to find evaluate different causes of cardiogenic shock as possible predictor of benefit of PVAD therapy.

Methods: In a retrospective monocentric registry study, we included 17 consecutive patients in cardiogenic shock supported with ECLS combined with PVAD for LV-unloading between April 2014 and April 2017. Patients' baseline characteristics were collected at initiation of therapy and outcomes after 30 days.

Results: In survivors mean duration of ECLS was 9 days (range: 4 days – 19 days), mean duration of PVAD was 5 days (range: 1 day – 9 days). 30-day-survival was 24% (4/17). 10 patients (59%) died due to severe post resuscitation syndrome with profound cardiogenic shock, 2 patients (12%) died of cerebral hypoxia and 1 patient (6%) in severe multi-organ failure.

Survivors (mean age: 34.7 yrs., range: 21-61 yrs.) were all diagnosed with myocarditis, while in non-survivors, 8 were cannulated during cardiac arrest due to acute myocardial infarction, septic shock (4/17) or primary ventricular fibrillation (1/17). Severe vascular complications were recorded in 3/17 patients (18%) with compartment syndrome needing fasciotomy in two patients and peripheral hypo-perfusion despite full ECLS and PVAD support necessitating amputation in one patient. Predictors of survival were PVAD in myocarditis and younger patient age.

Table 1: Patient characteristics and device use

	survivors	non-survivors	all
number of patients	4	13	17
patient characteristics			
age [years]	34.7 [21-61]	52.3 [18-81]	48.2 [18-81]
male gender	25% [1]	85% [11]	71% [12]
device use			
duration ECLS [days]	9 [4-19]	4 [1-15]	5 [1-19]
duration PVAD [days]	5 [1-9]	3 [1-6]	4 [1-9]

Compared to all patients with ECLS after cardiac arrest treated at our institution, patients with LV-unloading had a tendency towards improved hospital survival (figure 2). Considering only patients without any cardiac output were considered for LV-unloading this is a encouraging result.

Figure 1: Left ventricular pressure-volume-loops in patients with ECLS without (red) and with PVAD (green) for ventricular unloading.

Figure 2: Survival of all patients with ECLS after cardiac arrest compared to survival of patients with ECLS and PVAD.

Conclusion: LV-venting by PVAD in ECLS patients is feasible. Especially in younger patients suffering from myocarditis, this might be a promising therapy. In patients with post-resuscitation syndrome, we could not show any benefit of PVAD therapy. Complications have to be taken into consideration and have to be addressed in larger case series in order to estimate a net clinical benefit.