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LV distention on VA-ECMO, what to do?

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Veno-arterial extracorporeal membrane oxygenation (VA-ECMO) is increasingly applied for the treatment of cardiogenic shock despite its high complication rate.[1] The lack of left ventricular unloading is one of the serious problems associated with the poor outcome of VA-ECMO. Therefore, hemodynamic management during VA-ECMO should address the higher afterload caused by the retrograde blood flow and the consequent left ventricular distension. In fact, the blood stasis can result in ventricle or pulmonary thrombosis. Moreover, a high end-diastolic pressure can cause pulmonary venous congestion and lung injury, as well as subendocardial malperfusion and consequently impair recovery.

Possible strategies to unload the left ventricle include inotropic support or intra-aortic balloon pump implantation, as described in 135 cases by Gass and colleagues.[2] Surgical left ventricle venting can be performed with the cannulation of the left atrium or the left ventricle although this strategy is highly invasive. Blade atrial septostomy or atrial septostomy and placement of a venting cannula are also described.[3,4]

Our group recently described a new strategy employing Impella on top of VA-ECMO in a large series of patients, compared with VA-ECMO only.[5] Impella device is a small heart pump that pulls blood from the left ventricle through an inlet area near the tip and expels blood from the catheter into the ascending aorta. The device was inserted percutaneously through the femoral artery into the ascending aorta, via the aortic valve into the left ventricle.

In compliance with the Declaration of Helsinki and in agreement with Italian and German data protection laws, we retrospectively collected data on patients with severe refractory cardiogenic shock from two tertiary critical care referral centers and enrolled 157 patients (January 2013 to April 2015): 123 received VA-ECMO support and 34 had concomitant

Table 1. Comparison of major outcomes between patients treated with veno-arterial extracorporeal membrane oxygenation (ECMO) and Impella and patients treated with veno-arterial ECMO only in the propensity score matching sample ($n = 63$).

Parameters	Total ($n = 63$)	ECMO + Impella ($n = 21$)	ECMO ($n = 42$)	P
Hospital mortality, *n* (%)	41 (65)	10 (48)	31 (74)	0.04
Bridge to next therapy or recovery, *n* (%)	28 (44)	13 (62)	15 (36)	0.048
Weaning from MCS, *n* (%)	26 (41)	10 (48)	16 (28)	0.047
Bridge to recovery, *n* (%)	19 (30)	8 (38)	11 (26)	0.3
Bridge to VAD, *n* (%)	8 (13)	4 (19)	4 (9.5)	0.5
Bridge to cardiac transplantation, *n* (%)	0	0	0	
Duration of ECMO, h	120 (36 – 234)	148 (72 – 239)	73.5 (29 – 217)	0.2
Duration of MV, h	93 (29 – 228)	163 (90 – 228)	48 (17 – 265)	0.04
CWH, *n* (%)	18 (29)	10 (48)	8 (19)	0.02
Hemolysis, *n* (%)	30 (48)	16 (76)	14 (33)	0.004
Major bleeding, *n* (%)	20 (32)	8 (38)	12 (29)	0.6
Minor bleeding, *n* (%)	14 (22)	4 (19)	10 (24)	0.8
LVEF at weaning, %	45.5 (30 – 55)	52.5 (47 – 55.5)	37.5 (25 – 50)	0.13

treatment with VA-ECMO and Impella implanted simultaneously. The decision for an additional implantation of Impella was undertaken as the attending physician recognized signs of echocardiographic, radiological, and clinical signs of impaired left ventricle unloading or left ventricle stasis (stone heart, pulmonary edema, impending clotting on the left ventricle, significant aortic regurgitation). Impella was left running at P8 speed in order to produce a forward flow of 2.0 L without complications.

A propensity-matching analysis was performed in a 2:1 ratio, resulting in 42 patients undergoing VA-ECMO alone (control group) compared with 21 patients treated with VA-ECMO and Impella. Patients in the VA-ECMO and Impella group had significantly lower hospital mortality (47% vs. 80%, $P < 0.001$) and a higher rate of successful bridging to either recovery or further therapy (68% vs. 28%, $P < 0.001$) compared with VA-ECMO patients. Other results are presented in Table 1.

In conclusion, among different strategies to unload the left ventricle during VA-ECMO, Impella can be considered a feasible option. Nevertheless, randomized studies are warranted to validate this strategy.

Keywords: VA-ECMO, Impella, left ventricular distension, cardiogenic shock

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