Editorial

Mechanical circulatory support with ECMELLA approach in severe cardiogenic shock patients—state of the art

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The first application of an Impella microaxial pump for left ventricular (LV) unloading in veno-arterial extracorporeal life support (va-ECLS) patients was described in 2001 (1). Since then, temporary mechanical circulatory support (tMCS) technology has undergone significant improvements in terms of feasibility and durability, leading to better management and outcomes with these devices (2). Over the past 5 years, numerous publications have highlighted the advantages of combining va-ECLS and Impella (referred to as the ECMELLA approach) compared to va-ECLS alone (2-4). While the ECMELLA approach has now become a widely used therapy in the setting of severe cardiogenic shock (CS), several important challenges still need to be addressed in this context.

ECMELLA in particular is one of the most effective tMCS approaches, providing biventricular unloading in combination with blood oxygenation. However, ECMELLA is an invasive method and bears an increased risk for complications, and it is extremely important to identify those patients who could still benefit from it (2). Previous publications that have focused primarily on preoperative risk factors have demonstrated that elevated lactate and cardiopulmonary resuscitation (CPR) are a predictor of mortality in patients undergoing isolated Impella support (5). Others have shown the importance of timely LV unloading on va-ECLS (2-4).

Compared to existing literature, in their article Aludaat *et al.* address a very important implementation of ECMELLA, namely in patients who are already on tMCS with va-ECLS (6). The authors demonstrated that patients with a lactate >7.9 mmol/L on ongoing ECLS support did not benefit from a va-ECLS upgrade to ECMELLA. This finding is in line with the previously established preoperative cut-off of 8 mmol/L for isolated Impella use and once again emphasizes the significance of arterial lactate as a real-time ischemia indicator (5).

The authors identified the point of no return for patients on va-ECLS (6). However, an important question remained unanswered by their study: was the upgrade to ECMELLA performed too late? Could these patients have benefitted if the upgrade had taken place sooner? Who needs more than isolated ECLS and when? Can we answer these questions based on the presented study?

Timely LV unloading has a significant impact on patients' survival. In particular, a recent study by Radakovic *et al.* showed a clear survival benefit for prophylactic LV unloading over the bail-out approach when a patient's LV is already distended (3). The study by Schrage *et al.* reported that if LV unloading is initiated later than 2 hours after va-ECLS implantation the survival benefit vanishes (2).

In the publication by Aludaat *et al.* the time delay before Impella initiation not only biases the lactate level, but also directly impacts patients' survival itself (6). Especially since the time between ECLS and Impella implantation ranged between 0 and 48 (mean: 9) hours (6). Patients in the non-survivor group had a longer mean delay period compared to survivors {3 [0–14] *vs.* 13 [2–48]} (6). Therefore, the right suggestion would be to implant Impella as soon as possible after initiation of va-ECLS to achieve optimal body perfusion and prevent the sequelae of suboptimal LV unloading (7).

Additionally, it should be noted that the last lactate measurement prior to Impella initiation provides only a snapshot of the patient's metabolic condition and does not capture the overall dynamics (8). Unlike CS patients in whom lactate is measured before tMCS initialization, patients already on support require a different interpretation of the lactate measurement. Relying solely on a single parameter makes it challenging to accurately evaluate the circulatory situation, particularly in terms of lactate level trends and whether the patient received adequate va-ECLS support during the measurement (8). In particular, if patients present increasing lactate on tMCS or no adequate decrease, the circulatory support strategy should be optimized, meaning an increase in total tMCS flow (8).

In this context, the lactate dynamic could potentially be more promising for patients on tMCS and predict a critical hemodynamic state before increased levels are reached. Assessing lactate clearance could aid in decision making regarding support escalation and optimization of the current therapy. Therefore, before deciding against an ECMELLA upgrade due to an increase in lactate, it is crucial to re-evaluate the ongoing circulatory support strategy first.

Another point that has to be taken into consideration for ECMELLA therapy is the cannulation strategy. In hemodynamically critical situations [e.g., ongoing CPR, Interagency Registry for Mechanically Assisted Circulatory Support (INTERMACS) profile 1] rapid initialization of tMCS is crucial. In this scenario, percutaneous va-ECLS implantation is the therapy of choice (9). After circulatory stabilization, LV unloading should be performed immediately. In their article, Aludaat *et al.* opted for a surgical access via the axillary or femoral artery for Impella cannulation on top of femoral va-ECLS, based on the recovery potential of the patient (6).

The need for two arterial access sites for va-ECLS and Impella increases the risk of access-related complications such as bleeding, vessel damage, and infections (3,4). The novel single-artery access technique (ECMELLA 2.0) presented by Eulert-Grehn *et al.* aims to achieve patient mobilization while simultaneously reducing the risk associated with the cannulation technique (10). In this technique, a Y-shaped prosthesis anastomosed to the axillary artery is used for placement of both the Impella and the arterial cannula of the ECLS (10). In our opinion, the single arterial approach should be prioritized if the patient's condition allows, since ECMELLA 2.0 is technically more challenging and time consuming compared to conventional techniques. Otherwise, a cannulation switch to ECMELLA 2.0 can be performed (10).

In conclusion, several important questions still need to be addressed to optimize the ECMELLA approach. First, identifying the patients who benefit the most from ECMELLA is crucial, considering its invasive nature and potential complications. The evaluation of preoperative factors, such as elevated lactate levels, can help determine the appropriate candidates for different tMCS configurations. However, if the patient is already on tMCS (e.g., isolated va-ECLS, Impella) the lactate dynamic over time and the optimal level of support has to be considered before denying a patient an ECMELLA upgrade.

Second, it is essential to minimize the time delay before LV unloading. Studies have shown that early initiation of LV unloading provides a survival benefit, emphasizing the importance of a prophylactic approach. Finally, the optimal technique for ECMELLA implantation plays a major role. While a percutaneous approach is suitable for rapid initialization of tMCS in critical hemodynamic states, the novel single arterial access technique (ECMELLA 2.0) offers the advantage of reducing access-related complications and enabling patient mobilization. However, the decision on the cannulation strategy should be based on the individual patient's recovery potential. Future research should focus on addressing these questions to further refine the use of ECMELLA and tailor its application to severe cardiogenic shock patients.

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