Letter to the Editor

# The tightrope walk between temporary and permanent mechanical circulatory support

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In recent years, tremendous progress has been made in treatment and management of chronic heart failure, with novel drugs and devices contributing to reduced mortality and improved quality of life. In contrast, acute heart failure and cardiogenic shock have seen no such advancement in therapy and lack large positive outcome trials (1,2). Concomitantly, there is a strong rise in the use of temporary mechanical circulatory support (MCS) for cardiogenic shock (3,4), and some centers also implant permanent left ventricular assist devices (LVAD) at INTERMACS stages 1 to 3 (5). Yet, evidence from randomized controlled trials for temporary or permanent MCS remains limited, not at least because controlled MCS studies in acute heart failure and cardiogenic shock are admittedly difficult to conduct and to interpret. Therefore, MCS decision making in acute cardiac conditions is still largely based on experience and sometimes empiricism, and bridging and weaning strategies vary between centers. In this context, we read with great interest the report of Osswald and colleagues (6).

The authors report the case of a patient with acute anterior myocardial infarction, who developed recurrent ventricular fibrillation three weeks after the event resulting in extracorporeal cardiopulmonary resuscitation. The patient was transferred on veno-arterial extracorporeal membrane oxygenation (VA-ECMO) to their center and since weaning of VA-ECMO appeared unsuccessful, decision to implant a permanent LVAD was made. After one year the patient presented with pump thrombosis, and systemic thrombolysis was associated with intracranial bleeding, which was managed by surgical evacuation. Later on the patient experienced re-thrombosis of the pump, and in the presence of recent intracranial bleeding the team decided for a weaning attempt of the LVAD. Again a VA-ECMO was implanted with femoral cannulation, the LVAD was explanted, and the patient was treated with four different catecholamines. VA-ECMO was associated with limb ischemia, which prompted the authors to use an Impella 5.0 microaxial pump with subclavian arterial access to facilitate VA-ECMO explantation. The Impella was removed after weaning already on day five, and the patient finally survived without permanent MCS.

The presented case prototypically illustrates the challenges of timing and decision making as well as the risks of MCS. The patient had (sub-) acute left ventricular (LV) failure, which was sequentially treated with VA-ECMO, LVAD, VA-ECMO and Impella support. Numerous adverse events occurred during ECMO and LVAD support, including spinal cord syndrome, LVAD pump thrombosis and re-thrombosis, intracranial bleeding with neurosurgical treatment, and limb ischemia. Given that the patient initially had preserved right ventricular systolic function and LV failure due to a recent acute coronary syndrome, we speculate whether a strategy without permanent MCS would have been feasible. LV systolic function and recovery were estimated on VA-ECMO support during the peri-infarct phase. VA-ECMO with femoral cannulation is sufficient

for end organ perfusion, but reduces cardiac preload and provides retrograde aortic blood flow support, resulting in an essentially artificial environment for the LV (7,8). Three weeks after acute myocardial infarction a LV ejection fraction of 15% with pulmonary edema in the presence of VA-ECMO would thus not generally indicate that the LV is unable to recover. Overall, we doubt that requirement for LVAD surgery can be universally adjudicated from failure to wean off VA-ECMO. We rather propose that initially a switch from the first VA-ECMO to an Impella 5.0 (9) would have established LV unloading and sufficient end-organ perfusion at the same time, with the chance for awake support, mobilization, decision making and bridge-to-recovery. As the patient could be weaned from MCS one year after myocardial infarction, we estimate the chance for successful weaning three weeks after the acute event as equally high. While we are waiting for robust randomized study data on different MCS devices, we hypothesize that VA-ECMO support in this vulnerable phase may even decrease the chance of myocardial recovery. That said, we speculate that prolonged temporary LV unloading during the peri-acute phase, which is characterized by various ongoing processes of infarct healing, would finally contribute to increased recovery potential of the diseased heart with mitigated adverse remodeling.

The recent technological progress of permanent MCS devices and improved surgical techniques both contribute to increasing and successful use of LVADs for destination therapy in chronic heart failure. Notwithstanding, we should put all efforts into achieving myocardial recovery in patients with acute heart failure. This will likely require prolonged use of temporary MCS, further facilitated by future generations of percutaneous LV unloading devices with upper-body access.

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## Footnote

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*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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