EXTRACORPOREAL MEMBRANE OXYGENATION (ECMO) RESCUE THERAPY IN POST-CARDIOTOMY CARDIOGENIC SHOCK: A CASE REPORT

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Abstract
Cardiogenic shock is a constant challenge for the intensivist when complicating a myocardial infarction, due to the high rate of associated morbidity and mortality, especially in the setting of mechanical complications such as papillary muscle rupture.
We present the case of a 49-year-old woman with cardiogenic shock due to acute myocardial infarction (AMI) complicated by severe mitral valve insufficiency due to papillary muscle rupture. She was treated initially by medical optimization, followed by mitral valve replacement and complete surgical revascularization, requiring rescue mechanical circulatory support by extracorporeal membrane oxygenation (ECMO). ECMO proved to be a rescue therapy in a patient with refractory cardiogenic shock after urgent cardiac surgery.

Keywords
cardiogenic shock, mechanical circulatory support

Introduction
Refractory cardiogenic shock can be defined as ongoing evidence of tissue hypoperfusion despite administration of adequate doses of two vasoactive medications and treatment of the underlying etiology. It carries a hospital mortality as high as 50%. Cardiopulmonary support with veno-arterial extracorporeal membrane oxygenation (ECMO) has been proved to be a useful tool in the management of shock syndromes. In cardiac surgery, in the perioperative period, ECMO is rapidly evolving as a readily available tool for rescue therapy in rapidly deteriorating patients as it offers multi-organ support and can be placed in patients with left ventricular (LV), right ventricular (RV), or bi-ventricular failure.

Patient presentation and initial workup
A 49-year-old female was admitted directly to the intensive care unit (ICU) from another institution, after having suffered a silent myocardial infarction (MI), possibly in the previous 7 days, complicated by a papillary muscle rupture with severe mitral valve regurgitation. At admission, the patient was mechanically ventilated and showed signs of cardiogenic shock and organ dysfunction, i.e. cold, clammy skin, anuria with elevated serum creatinine, elevated serum lactate (6 mmol/l), and severe LV dysfunction (LV ejection fraction [LVEF] 30%), on transthoracic echocardiographic (TTE) examination. Standard monitoring was supplemented by an arterial line placed on the left radial artery and a pulmonary artery catheter via the right jugular vein.

Diagnosis and management
Transthoracic echocardiography (TEE) confirmed posterior papillary muscle rupture, with severe mitral regurgitation and severe LV dysfunction (Figure 1).
Initial workup was completed with a coronary angiography, which showed triple-vessel coronary artery disease. At this point, the institutional Heart Team (including a cardiologist, cardiovascular surgeon, and anesthesiologist) decided that, given the high mortality risk (Euroscore II 31.47%, Sequential Organ Failure Assessment [SOFA] score 10), initial management should focus on stabilizing the patient, with surgery planned in the same hospitalization.
An intra-aortic balloon pump (IABP) was inserted via the right femoral artery, and the patient was optimized by multimodal treatment, including inodilator therapy with levosimendan...
with no signs of pulmonary congestion. No further organ dysfunction developed. Postoperatively, there was no need of CRRT.

Weaning was undertaken using an ultrasound-guided protocol and IV inodilators (levosimendan) and was successful on postoperative day 10. The patient was extubated on postoperative day 12. The IABP was removed 2 days later. The TEE examination after weaning showed an LVEF of 40%, normal RV, and adequate mechanical mitral valve function. The patient was shifted to the ward on postoperative day 20 and discharged from the hospital 1 week later.

Discussion

International guidelines recommend emergency surgery in cases presenting with mechanical complications of acute myocardial infarction (AMI), although perioperative mortality is high. The risk of mortality is even higher in cases admitted with preoperative cardiogenic shock. Hemodynamic stabilization is based on afterload reduction and inotropic treatment plus diuretics. In our patient, IABP was used for afterload reduction and levosimendan for both inotropy and afterload reduction. As the patient had anuria from the presentation, CRRT with hemodiafiltration aimed to control the fluid, electrolytic, and metabolic balance. This strategy resulted in a reduction of the regurgitant volume and increased cardiac output, allowing for optimization of the patient's condition preoperatively. While not routinely recommended in cardiogenic shock, IABP is indicated for circulatory support in mechanical complications of AMI. Levosimendan has been advocated as a useful agent in both cardiogenic shock and for weaning of veno-arterial ECMO. Unfortunately, the use in patients on CRRT has an unpredictable effect on the parent agent and its metabolites, and consequently on the hemodynamics.

Despite the complete revascularization and replacement of insufficient valve, the patient developed postoperative cardiogenic shock refractory to conventional therapy. Using a stepwise approach, the next choice was to use ECMO as a rescue mechanical circulatory support and bridge to recovery. Compared to other short- and long-term circulatory assist devices, ECMO offers the advantage of both cardiac (bi-ventricular) and respiratory support. Organ support was optimal, as documented by lack of new-organ dysfunction and normal serum lactate levels, and LV unloading was effective through the IABP which was already in place. Cardiac function recovered slowly under ECMO, and weaning was uneventful after 9 days of circulatory support. An ultrasound-guided weaning strategy was used, and the patient was discharged home in a good condition.
Conclusions

Mechanical complications of AMI associated with cardiogenic shock represent a challenging setting for the Heart Team. Mechanical circulatory support is needed both pre- and postoperatively, and a stepwise approach is recommended. ECMO as a rescue therapy in a patient with refractory cardiogenic shock after urgent cardiac surgery, already on IABP, inotropic, vasoconstrictor support, and inhaled NO proved to be successful.

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Disclosure

None

References

[1] Reyentovich A, Barghash MH, Hochman JS. Management of refractory cardiogenic shock. Nature Reviews Cardiology. 2016 Jun 30;13:481.

[2] Wilson-Smith AR, Bogdanova Y, Roydhouse S, Phan K, Tian DH, Yan TD, et al. Outcomes of venoarterial extracorporeal membrane oxygenation for refractory cardiogenic shock: systematic review and meta-analysis. Annals of Cardiothoracic Surgery. 2019 Jan;8(1):1–8.

[3] Agewall S, Antunes MJ, Bucciarelli-Ducci C, Bueno H, Caforio ALP, Crea F, et al. 2017 ESC Guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. 2017;66.

[4] Liakopoulos OJ, Schlachtenberger G, Wendt D, Choi Y, Slottosch I, Welp H, et al. Early Clinical Outcomes of Surgical Myocardial Revascularization for Acute Coronary Syndromes Complicated by Cardiogenic Shock: A Report From the North-Rhine-Westphalia Surgical Myocardial Infarction Registry. JAH [Internet]. 2019 May 21 [cited 2019 Sep 6];8(10). Available from: https://www.ahajournals.org/doi/10.1161/JAHA.119.012049

[5] Ponikowski P, Voors AA, Anker SD, Bueno H, Cleland JGF, Coats AJS, et al. 2016 ESC Guidelines for the diagnosis and treatment of acute and chronic heart failure: The Task Force for the diagnosis and treatment of acute and chronic heart failure of the European Society of Cardiology (ESC)Developed with the special contribution of the Heart Failure Association (HFA) of the ESC. Eur Heart J. 2016 Jul 14;37(27):2129–200.

[6] Cholley B, Levy B, Fellahi J-L, Longrois D, Amour J, Ouattara A, et al. Levosimendan in the light of the results of the recent randomized controlled trials: an expert opinion paper. Crit Care. 2019 Dec;23(1):385.

[7] Hajjar LA, Teboul J-L. Mechanical Circulatory Support Devices for Cardiogenic Shock: State of the Art. Crit Care. 2019 Dec;23(1):76.

[8] Ortuno S, Delmas C, Diehl J-L, Bailleul C, Lancelot A, Nalì M, et al. Weaning from veno-arterial extra-corporeal membrane oxygenation: which strategy to use? Ann Cardiothorac Surg. 2019 Jan;8(1):E1–8.