VA-ECMO in Cardiogenic Shock as a Bridge to Heart Transplantation

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Introduction

The use of venoarterial extracorporeal membrane oxygenation (VA-ECMO) in cardiogenic shock as a direct bridge to heart transplantation is highly controversial. Most hospitals only use VA-ECMO as a bridge to decision, recovery, or other long-lasting devices.[1-3]

We report a successful case of VA-ECMO as a bridge to urgent heart transplantation in a patient in INTERMACS I cardiogenic shock. There was complete recovery of tissue oxygen and renal and liver functions, allowing for heart transplant in a patient with overall improved organ functions. In selected cases, VA-ECMO is a relatively low-cost alternative to mechanical circulatory support that could be more easily implemented in Brazilian hospitals.

Case Report

A 55-year-old male patient with no known comorbidities developed cough, edema, and dyspnea with progressive worsening approximately 2 months earlier. There were no viral or infectious prodromes. The patient was initially treated for pneumonia in another hospital with piperacillin-tazobactam and clarithromycin. A respiratory viral panel including influenza, respiratory syncytial virus, and SARS-CoV-2 was negative for all viruses.

An echocardiogram was performed during hospitalization and showed significant dilation of the cardiac chambers (left ventricle: 70 mm; right ventricle: 36 mm) with marked increase of the left atrium (left atrial volume index of 74 cm^2). The absence of tricuspid regurgitation did not allow for measurement of pulmonary artery systolic pressure.

After 4 weeks of hospitalization, the patient's clinical condition continued to deteriorate despite heart failure treatment. He developed systemic and pulmonary congestion resistant to diuretics, progressive worsening of renal function, increased liver transaminases, hypotension, and clinical signs of low cardiac output. The patient was started on 10 mcg/kg/min dobutamine and referred to our hospital for evaluation by the heart transplant team.

Keywords

ECMO; Cardiogenic Shock; Transplant

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The patient arrived in our hospital in INTERMARCS II cardiogenic shock and sinus tachycardia, with a heart rate of 122. He also had low blood pressure, poor peripheral perfusion, anuria, and anasarca, requiring immediate continuous hemodialysis. The use of a Swan-Ganz catheter identified the following: cardiac index 1.4 L/min/m^2, PAP 32/23 mm Hg, PAOP 21, CVP 12, SVR 1,066 dynes/seconds/cm^5, and PVR 148 dynes/seconds/cm^5 (Figure 1).

An intra-aortic balloon pump (IABP) was inserted, but there was poor clinical response. The patient became severely hypotensive, with a reduced level of consciousness, progressive increases in lactate levels, and signs of liver dysfunction despite the use of 20 mcg/kg/min dobutamine, 0.1 mcg/kg/min norepinephrine, and 1:1 IABP support. Orotracheal intubation was required.

Due to the patient's deterioration to INTERMACS I cardiogenic shock, we implanted a temporary mechanical circulatory assist device (peripheral VA-ECMO via the femoral artery). After clinical stabilization, an evaluation protocol for heart transplantation was initiated. The IABP was maintained to prevent LV hyperdistention, whereas continuous hemodialysis was maintained with the goal of aggressive negative fluid balance attainment (Figure 2).

After VA-ECMO implant, the patient progressed with rapid hemodynamic improvement and normalization of tissue perfusion and lactate levels and was extubated after 48 hours. There was also improvement of renal function, with discontinuation of renal replacement therapy after 7 days, and normalization of liver function and transaminases.

After 1 week on circulatory support, the patient was placed on the heart transplant waiting list with a priority status. After 14 days, the patient underwent a heart transplant, but there was severe right ventricular dysfunction during VA-ECMO weaning, thus we decided to maintain VA-ECMO until right ventricular function was recovered. On postoperative day 4, right ventricular function was completely stabilized, and the patient was successfully weaned off VA-ECMO. The patient was discharged from the intensive care unit on postoperative day 9 and from the hospital on postoperative 18 in good general condition for outpatient follow-up.

Pathological examination of the surgical specimen showed signs of lymphocytic myocarditis, dilated heart disease, and arterial thrombosis. Immunohistochemistry and viral investigation were not performed due to limitations in the pathology service.

Discussion

Despite several advances in recent years, cardiogenic shock remains a major challenge in critical care cardiology, with very high mortality rates and a scarcity of well-structured hospitals that can provide adequate care for this patient population.[4-6]

According to the Acute Heart Failure Guidelines, the use of mechanical circulatory assist devices is indicated in patients

Case Report

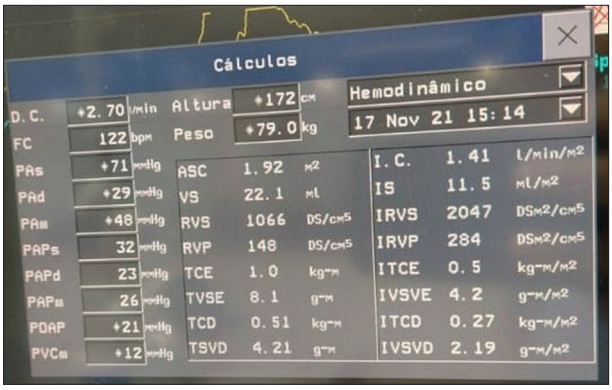

Figure 1 – *Swan-Ganz measurements immediately after patient admission.*

with INTERMACS II or I cardiogenic shock.[4,6] However, these devices are not available in most Brazilian hospitals.

Peripheral VA-ECMO is a short-term, relatively low-cost, easy-to-implement circulatory assist device. Considering how difficult it often is to provide medium-term devices for patients on the heart transplant waiting list, especially those with severe biventricular dysfunction who progress to INTERMACS II or I cardiogenic shock, peripheral VA-ECMO may be a viable and cost-effective alternative in selected cases and in hospitals with reduced waiting time for a heart transplant.[1]

In this case report, we showed that, although controversial, VA-ECMO can be successfully used as a direct bridge to transplantation in some hospitals in selected cases.[1-3] Author

Figure 2 – *Hemodynamic improvement after intra-aortic balloon pump and venoarterial extracorporeal membrane oxygenation implantation.*

Contributions

Conception and design of the research, Acquisition of data, Writing of the manuscript and Critical revision of the manuscript for intellectual content: Chaves RB, Ulhoa MB, Araújo MCCL; Analysis and interpretation of the data and Statistical analysis: Chaves RB, Ulhoa MB.

Potential Conflict of Interest

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Study Association

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Ethics approval and consent to participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. Hébert M, Noly PE, Lamarche Y, Bouhout I, Mauduit M, Giraldeau G, et al. Early and Long-Term Outcomes after Direct Bridge-to-Transplantation with Extracorporeal Membrane Oxygenation. Heart Surg Forum. 2021;24(6):1033-42. doi: 10.1532/hsf.3861.
2. Poptsov V, Spirina E, Dogonasheva A, Zolotova E. Five years' Experience with a Peripheral Veno-arterial ECMO for Mechanical Bridge to Heart Transplantation. J Thorac Dis. 2019;11(Suppl 6):889-901. doi: 10.21037/jtd.2019.02.55.
3. Montisci A, Donatelli F, Cirri S, Coscioni E, Maiello C, Napoli C. Veno-arterial Extracorporeal Membrane Oxygenation as Bridge to Heart Transplantation: The Way Forward. Transplant Direct. 2021;7(8):e720. doi: 10.1097/TXD.0000000000001172.
4. Guglin M, Zucker MJ, Bazan VM, Bozkurt B, El Banayosy A, Estep JD, et al. Venoarterial ECMO for Adults: JACC Scientific Expert Panel. J Am Coll Cardiol. 2019;73(6):698-716. doi: 10.1016/j.jacc.2018.11.038.
5. Chambrun MP, Bréchot N, Combes A. Venoarterial Extracorporeal Membrane Oxygenation in Cardiogenic Shock: Indications, Mode of Operation, and Current Evidence. Curr Opin Crit Care. 2019;25(4):397-402. doi: 10.1097/MCC.0000000000000627.
6. Rohde LEP, Montera MW, Bocchi EA, Clausell NO, Albuquerque DC, Rassi S, et al. Diretriz Brasileira de Insuficiência Cardíaca Crônica e Aguda. Arq Bras Cardiol. 2018;111(3):436-539. doi: 10.5935/abc.20180190.