Extracorporeal membrane oxygenation for right ventricular failure following pericardiectomy

Authors: Hasham Ahmad[1], Richard Porter[2], Hakeem Yusuff[2], Marius Roman[1]

Author affiliations:

1 Department of Cardiac Surgery, Glenfield Hospital, University Hospitals of Leicester, UK

2 Intensive Care Unit and ECMO Unit, Glenfield Hospital, University Hospitals of Leicester, UK

Corresponding Author

Hasham Ahmad BSc (Hons), MBChB

Department of Cardiac Surgery, Glenfield Hospital, University Hospitals of Leicester, UK

+44 (0)7892738965; hashamahmad@doctors.org.uk

Keywords: Pericardiectomy, Pericarditis, Constrictive Pericarditis, Extracorporeal Membrane Oxygenation.

Words count: 1000

Abstract

We report the case of a 61-year old gentleman who underwent pericardiectomy for constrictive pericarditis (CP). CP was diagnosed through echocardiogram, CT chest and cardiac MRI. An elective decision was made for commencing veno-arterial extracorporeal membrane oxygenation (VA-ECMO) immediately post-operatively to prevent significant right ventricular failure (RVF). Post-operatively, the patient remained on ECMO for 4 days in a stable condition, showing no further signs of right ventricular failure. VA-ECMO may be of use as an elective adjunct in cases at high risk of RVF following pericardiectomy.

Background

Pericardiectomy for patients with constrictive pericarditis (CP) is not a commonly performed cardiac surgery operation, and there is limited experience in the management strategies.[1] Previous evidence suggests that without surgical intervention, progression of CP causes significant worsening of right heart failure and commonly early death.[2] Veno-arterial extracorporeal membrane oxygenation (VA-ECMO) is a developing method of providing cardiorespiratory mechanical support, with early reports indicating low thresholds in patients developing right ventricular failure (RVF).[2-4] We report a case of patient with CP at high risk of developing RVF postoperatively, who was placed electively on VA-ECMO in the immediate postoperative period.

Case Report

The patient presented with worsening breathlessness, decreasing exercise tolerance capacity and weight loss. Past medical history included severe pectus excavatum, with reduced left lung volume and mediastinal shift. He underwent a left pleural biopsy, which showed inflammatory changes, with no evidence of malignancy. CP was diagnosed through Transthoracic Echocardiogram (TTE), CT Chest, and Cardiac MRI. The patient was considered to be at high risk for developing RV failure postoperatively based on a combination of: decreased preload (due to the constrictive pericarditis and presence of pericardial effusion), dilated RV (assessed by MRI and TOE parameters) and raised PVR due to left lung collapse.

Transthoracic echocardiogram

Pericardium appeared bright and thickened. A pericardial collection was measured at 1.6cm. Respiratory variation and flow reversal into the hepatic vein were noted. The inferior vena cava (IVC) was normal in size, with <50% collapse changes.

CT Chest

Widespread pleural and pericardial thickening was reported, alongside severe pectus excavatum contributing to the reduction in left thoracic volume.

Operation

ECMO cannulation was performed electively as a pre-operative step via the left common femoral vein and right common femoral artery. A phrenic to phrenic excision extending to the diaphragm and neck vessels was performed. Once the constriction of the right ventricle and right atrium was released, these became distended with the elevated right atrial pressures and the TOE demonstrated a transient deterioration in RV function. The RV dysfunction was quantified through the following parameters: 1. Dilated RV – quantified by the RV/LV ratio=1.2 (normal value ≤1); 2. TAPSE=1cm (normal >1.6cm in ventilated or 2.4cm in non-ventilated

patients); 3. A straight septum appearance in end-systole; 4. Poor radial RV function. The right ventricular function was seen to improve progressively on TOE.

The patient remained on ECMO for 4 days post-operatively. Following the successful wean from ECMO, the de-cannulation was performed through a surgical cut-down and primary closure. Mildly deranged liver function tests (ALP 185IU/L, ALT 21IU/L) and coagulation profile were noted. These normalised prior discharge, while ultrasound scans showed no signs of liver failure or liver congestion.

Histology

Both pleural and pericardial biopsies showed non-specific inflammation and diffuse benign fibrosis. There were no features to suggest IgG4 disease.

Cardiac MRI

There is an increase in the LV/RV volume and decreased end diastolic pressure when comparing the post-pericardiectomy with the pre-operative Cardiac MRI. There is marked reduction in thickening surrounding the heart post-operatively. **(Figure 1)**

Discussion

The NICE guidelines state that the use of VA-ECMO in acute heart failure is adequately evidenced, however, there is uncertainty about which patients are likely to benefit from elective VA-ECMO.[2] The current limited evidence on safety shows a high incidence of serious complications.[3,5]

Some aspects are unique in this case: (i) the severe pectus excavatum, reducing the left thoracic volume; (ii) no histological evidence for IgG4 related disease and (iii) the use of VA-ECMO as elective adjunct for definitive surgery. In this case, VA-ECMO allowed the survival and recovery of the patient through the critical post-operative period, without the presence of significant right heart failure. This approach may be considered as a bridge and risk reduction strategy in patients at high risk of developing RV dysfunction following pericardiectomy. The implementation of this approach and threshold should be supported by further randomised controlled trials.

Sources of funding

No conflict of interests or funding is declared by the authors.

Figure (and video) legends

Figure 1 Cardiac MRI: (a) pre-pericardiectomy and (b) post-pericardiectomy.

References

1. Busch C, Penov K, Amorim PA, Garbade J, Davierwala P, Schuler GC, et al. Risk factors for mortality after pericardiectomy for chronic constrictive pericarditis in a large single-centre cohort. Eur J Cardiothorac Surg. 2015 Dec;48(6):e110-6. doi: 10.1093/ejcts/ezv322.
2. Beckmann E, Ismail I, Cebotari S, Busse A, Martens A, Shrestha M, et al. Right-Sided Heart Failure and Extracorporeal Life Support in Patients Undergoing Pericardiectomy for Constrictive Pericarditis: A Risk Factor Analysis for Adverse Outcome. Thorac cardiovasc Surg 2017; 65(08): 662-670. doi:10.1055/s-0036-1593817
3. Lafçı G, Budak A, Yener A, Cicek O. Use of Extracorporeal Membrane Oxygenation in Adults. Heart, Lung and Circulation. 2014;23(1):10-23. doi:10.1016/j.hlc.2013.08.009.
4. Taghavi S, Zuckermann A, Ankersmit J, Wieselthaler G, Rajek A, Laufer G, et al. Extracorporeal Membrane Oxygenation is Superior to Right Ventricular Assist Device for Acute Right Ventricular Failure After Heart Transplantation. The Annals of Thoracic Surgery. 2004;78(5):1644-1649. doi:https://doi.org/10.1016/j.athoracsur.2004.04.059
5. Makdisi G, Wangcorresponding I. Extra Corporeal Membrane Oxygenation (ECMO) review of a lifesaving technology. Journal of Thoracic Disease. 2015 Jul; 7(7): E166–E176. doi:10.3978/j.issn.2072-1439.2015.07.17