The expanding role of extracorporeal membrane oxygenation retrieval services in Australia


Summary

Herein we detail the cases of three patients transferred on veno-arterial extracorporeal membrane oxygenation (VA ECMO) from a tertiary referral hospital to an ECMO centre. We highlight the benefits of such a transfer and offer this as a model of care for unwell patients likely to require a prolonged period of ECMO support.

Key Words: extracorporeal membrane oxygenation, retrieval

The New South Wales (NSW) extracorporeal membrane oxygenation (ECMO) Retrieval Service was originally developed to provide veno-venous (VV) ECMO support to patients with severe respiratory failure in hospitals without access to this technology. More recently, the role of this service has expanded to include the provision of ongoing support for patients in cardiogenic shock at hospitals that can initiate ECMO, but do not provide ongoing management, as highlighted by the following three cases from Canberra Hospital, ACT, Australia, who were retrieved to Royal Prince Alfred Hospital (RPAH), Sydney. Each patient gave written consent for details to be published in this article.

Case Study 1

A 50-year-old man was admitted with a pilonidal abscess requiring incision and drainage. Two days later, he had a cardiac arrest, which responded to advanced cardiac life support and high-dose inotropes. Massive pulmonary embolism (PE) was suspected following echocardiography, which revealed a dilated and hypokinetic right ventricle (RV) with interventricular septal shift. Despite thrombolysis, he remained profoundly shocked, unresponsive to high-dose inotropes and had a recurrent cardiac arrest.

Peripheral femoral veno-arterial (VA) ECMO was established by a cardiothoracic surgeon and the patient retrieved to RPAH.

The following day, angiography revealed bilateral main pulmonary artery thrombi and normal coronary arteries. His subsequent clinical course was characterised by high inotrope requirements, severe vasoplegia, bleeding from cannulation sites, and acute renal failure, requiring renal replacement therapy.

However, on day two, repeat angiography revealed some resolution of pulmonary thrombi and he was successfully weaned from ECMO and decannnulated. An inferior vena cava (IVC) filter was placed at that time. He was extubated two days later and eventually discharged home with normal cardiac, respiratory and brain function.

Case Study 2

A 32-year-old woman was transferred to Canberra Hospital from Goulburn Hospital with hypoxia and haemodynamic collapse. She had recently travelled overseas, where she had sustained a soft tissue injury to her lower leg. Echocardiography findings were consistent with massive PE and systemic thrombolysis was administered. Surgical pulmonary embolectomy was performed due to ongoing haemodynamic instability. Postoperatively she remained severely shocked and progressive multi-organ failure ensued due to severe right ventricular failure, which was refractory to high-dose inotropes. Peripheral femoral VA ECMO was established and the patient was retrieved to RPAH.

ECMO support was weaned on day seven and an IVC filter placed following decannulation. The admission was complicated by compartment syndrome requiring fasciotomy of the right thigh, rectal and vaginal bleeding, severe critical illness neuromyopathy and acute renal failure requiring renal replacement therapy. The duration of intensive care unit
stay was 53 days. Three months later she was discharged with normal cardiac, respiratory and renal function and was sent for physical rehabilitation with expectation of complete musculoskeletal recovery.

Case Study 3
A 52-year-old man suffered ventricular fibrillation (VF) at home and received cardiopulmonary resuscitation (CPR) from his wife. He had return of spontaneous circulation following defibrillation by paramedics. Following admission to hospital, he had multiple (>30) further episodes of VF requiring defibrillation, despite amiodarone and lignocaine infusions. Coronary angiography was normal. Peripheral femoral VA ECMO was established and he was transferred to RPAH.

He was decannulated from ECMO on day three (following a 24 hour period of haemodynamic stability) and extubated on day six. However, he had three further episodes of VF on day nine, each responding to defibrillation. Isoprenaline and quinidine were commenced. No cause for VF was identified, despite extensive further investigations, including cardiac magnetic resonance imaging and pharmacologic challenge. An electrophysiological study was not performed due to the infrequency of premature ventricular contractions. An automatic internal cardiac defibrillator was inserted and the patient was discharged home, neurologically intact.

Discussion
Our three cases highlight how the role of the NSW ECMO Retrieval Service has expanded to provide ongoing support for patients with cardiogenic shock who have ECMO initiated at a referring hospital.

From its inception in 2009, the NSW ECMO Retrieval Service initially provided mostly VV ECMO support for adult patients with severe respiratory failure. This service is provided at referring hospitals by teams from RPAH or St Vincent’s Hospital in Sydney. Over recent years, the proportion of VA ECMO cases (for severe cardiac failure) has increased, from less than 10% before 2011 to approximately 25% of the current annual caseload (15–30 patients). Because the median distance of cases retrieved was 250 km, the median time from referral to establishment of ECMO was 6.5 hours (interquartile range 4–8 hours). While this delay in establishing ECMO may be tolerated in patients with acute respiratory failure (who had an 87% rate of survival), this may not be the case in patients with acute, severe cardiogenic shock who require VA ECMO support. This delay can be reduced if the patient is in a cardiac surgical centre that can initiate VA ECMO support. Other advantages are that the referral centre can establish ECMO without the need to provide ongoing management, which requires medical, perfusion and nursing staff with specialised training. It also minimises the disproportionate impact on elective cardiac surgical and intensive care resources that would otherwise occur in these hospitals and provides their patients access to treatment in high-volume ECMO centres. Finally, it simplifies the logistics of the ECMO retrieval, as one less ECMO team member is required (i.e. the surgeon, anaesthetist or intensivist who would otherwise have performed the ECMO cannulation).

However, early communication between referring and receiving hospitals is essential and ideally should take place before ECMO is established at the referring hospital. This would ensure that there is agreement on the indications for ECMO support and on the subsequent management pathway prior to transfer. This is especially challenging in patients with massive pulmonary embolism, where the role of ECMO is poorly defined. Massive pulmonary embolism has a very high mortality with conventional treatment, increasing from 25% if cardiogenic shock occurs to 65% if CPR is required. However, in a recent review of ECMO support for massive PE, overall survival was 70%, and 49% when established during CPR. Once established, VA ECMO support can reverse end-organ injury while the embolic burden is addressed with thrombolysis, catheter, surgical or expectant management. Hence for Case 2, an alternative management strategy that would have avoided the risks of transporting a post-surgical patient would have been to establish ECMO, transfer the patient to an ECMO centre and then address the clot burden.

Early communication also provides a window of opportunity to conventionally transfer (non-ECMO retrieval) less critically ill patients who may yet require ECMO support. In addition to patients with massive PE, those with more severe submassive PE should be considered for early transfer to centres capable of performing VA ECMO. Hence our current ECMO referral network should be enhanced to facilitate the early recognition and transfer of these cases.

References