Extra-Corporeal Membrane Oxygenation in the Management of 2009 Influenza A (H1N1) Refractory Respiratory Failure

Abstract

Rapidly progressive acute respiratory failure attributed to 2009 H1N1 influenza A infection has been reported worldwide. Refractory hypoxaemia despite conventional mechanical ventilation and lung protective strategies has resulted in the use a combination of rescue therapies, such as conservative fluid management, prone positioning, inhaled nitric oxide, high frequency oscillatory ventilation and extracorporeal membrane oxygenation (ECMO). ECMO allows for pulmonary or cardiopulmonary support as an adjunct to respiratory and cardiac failure, minimising ventilator-associated lung injury (VALI). This permits treatment of the underlying disease process, while concurrently allowing for recovery of the acute lung injury. This case documents a previously healthy twenty-two year old Asian male patient with confirmed pandemic (H1N1) 2009 influenza A who was successfully managed with ECMO in the setting of severe refractory hypoxaemia and progressive hypercapnia.

Case Report

A 22 year old previously healthy Chinese student presented to the Emergency Department with a 6 day history of worsening dyspnea, myalgia and general malaise. On examination he was found to be pyrexic (38.5°C), hypotensive (100/67 mmHg) and tachyypnoeic (48 breaths/min). A chest radiograph (Figure 1) showed bilateral middle and lower zone consolidation and patchy ground glass opacities. An arterial blood gas sample confirmed severe hypoxaemia (PaO2 5.9 kPa). The patient was promptly transferred to the Intensive Care Unit for invasive ventilatory and cardio-pulmonary support as an adjunct to respiratory and cardiac failure, minimising ventilator-associated lung injury (VALI). This permits treatment of the underlying disease process, while concurrently allowing for recovery of the acute lung injury.

Discussion

Since 2009 H1N1 influenza A was first described and identified in Mexico, in the setting of severe refractory hypoxaemia and progressive hypercapnia with conventional ventilatory support (Murray Score 3.25, pH 7.23), the patient was transferred to the Karolinska Institute, Stockholm, Sweden for ECMO. The patient was initially treated with veno-venous ECMO but subsequently converted to veno-arterial ECMO with nitric oxide secondary to venous stasis and right ventricular failure. Complications during the course of ECMO treatment included spontaneous haemothorax requiring a thoracotomy, and ongoing gastrointestinal bleeding prompting cessation of ECMO support on Day 11. The patient was gradually weaned off pressure support ventilation over a 16 day period, and transferred back to Dublin. The total length of ventilatory support including ECMO was 66 days and hospital stay was 78 days. He recovered well with physical rehabilitation and retained full cognitive function.

Figure 1: Admission Chest Radiograph

Over the course of 8 days, the patient developed progressive worsening multiorgan failure requiring a protective lung ventilator strategy for severe acute respiratory distress syndrome (ARDS), ongoing vaspressor support, in addition to continuous renal replacement therapy. In the setting of refractory hypoxaemia and progressive hypercapnia with conventional ventilatory support (Murray Score 3.25, pH 7.23), the patient was transferred to the Karolinska Institute, Stockholm, Sweden for ECMO. The patient was initially treated with veno-venous ECMO but subsequently converted to veno-arterial ECMO with nitric oxide secondary to venous stasis and right ventricular failure. Complications during the course of ECMO treatment included spontaneous haemothorax requiring a thoracotomy, and ongoing gastrointestinal bleeding prompting cessation of ECMO support on Day 11. The patient was gradually weaned off pressure support ventilation over a 16 day period, and transferred back to Dublin. The total length of ventilatory support including ECMO was 66 days and hospital stay was 78 days. He recovered well with physical rehabilitation and retained full cognitive function.

An observational study of patients (n=68) with 2009 influenza A-associated ARDS treated with ECMO in 15 ICUs in Australia and New Zealand demonstrated an overall mortality of 21%. Peak et al evaluated the safety, clinical efficacy, and cost-effectiveness of ECMO and established that early transfer to an ECMO centre significantly improved survival without severe disability.

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facility was at full capacity. Although an invasive and complex procedure, commencing ECMO in a specialised centre should be considered in patients with rapidly progressive acute respiratory failure as a lifesaving measure when conventional mechanical ventilation and adjunctive non-ventilatory strategies have failed.

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References
5. 1H1N1 ECLS Registry http://www.elso.med.umich.edu/H1N1Registry.html