Extracorporeal membrane oxygenation support for 59 days without changing the ECMO circuit: a case of Legionella pneumonia

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We report the successful use of veno-venous extracorporeal membrane oxygenation (ECMO) in a 53-year-old patient with Legionella pneumonia and acute respiratory distress syndrome (ARDS) with severe barotraumas. The patient was supported for 59 days without any changes in the ECMO circuit. This is probably the longest support ever reported using the same oxygenator. Perfusion (2009) 24, 45-47.

Introduction

Veno-venous extracorporeal membrane oxygenation (ECMO) is an established therapy for the treatment of an acute hypoxemic respiratory failure that is unresponsive to conventional treatment. ECMO maintains adequate gas exchange during severe respiratory failure, providing an optimal environment for healing diseased lungs. However, complications created by the ECMO circuit per se, (i.e., mechanical breakdown, hemolysis, and thrombosis) have commonly required costly and dangerous changes in the circuitry. We describe a case of a 53-year-old male with severe acute respiratory distress syndrome (ARDS) that required ECMO for survival. He was successfully supported for 59 days on veno-venous ECMO with the same oxygenator.

Case report

A previously healthy 53-year-old man was admitted with symptoms of influenza and chest pain. Legionella infection was diagnosed. After 14 days, his condition deteriorated and he required mechanical ventilation with high airway pressures. Prone position did not improve oxygenation and the patient was transferred to our hospital.

The patient was initially on pressure-controlled ventilation with the following settings: fraction of inspired oxygen (FiO2) 0.9, peak pressure 39cm H2O, positive end-expiratory pressure 15cm H2O, respiratory rate 30-32/min. A pulmonary artery catheter was inserted to monitor hemodynamics. The patient's condition deteriorated further despite continuous support with different types of ventilation (continuous positive airway pressure-assist support breath, bi-level positive airway pressure, and airway pressure release ventilation (APRV)). He developed severe hypoxia (pO2 < 7 kPa), and, on day 16, his chest X-ray showed significant pneumothorax bilaterally. Bilateral pleural tubes were inserted. At this point, he had been mechanically ventilated for 16 days which, under ordinary circumstances, would be considered an exclusion criterion for ECMO support in our institution. However, because he experienced single organ failure only, he was considered eligible for veno-venous ECMO.

On day 20, veno-venous ECMO was instituted with a 17 French Carmeda®-coated (Biomedicus®, Medtronic, MN, USA) arterial, wire-reinforced, percutaneous cannula inserted into the right femoral vein. A second 19F cannula, Carmeda® coated (Biomedicus®, Medtronic), was inserted into the right internal jugular vein and advanced into the right atrium for venous drainage. The ECMO circuit consisted of a Rotaflo™ centrifugal pump (Maquet, Hirrlingen, Germany) and a Quadrox PLST™ oxygenator (Maquet). The whole ECMO circuit was totally coated with Bioline heparin coating (Maquet). The bypass began with flow rates that varied from 3 to 4 l/min. Continuous intravenous

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heparin, (Heparin Leo®, Ballerup, Denmark) was given to keep the activated clotting time between 150-180 sec.

There was no initial improvement in respiratory function. We used 100% FiO₂, both on the ECMO and the ventilator (APRV). The patient’s circulation was stable, producing urine with a low dose of infused furosemide. The pneumothorax increased on the left side, requiring additional chest tubes.

The condition was unimproved after three weeks of ECMO support. The pneumothorax problems were significant, with persistent air leakage (200-300 ml/min) from both pleural cavities. We reduced mechanical ventilation, as there was a minimal contribution of oxygenation from the lungs.

There were no complications with the ECMO circuit. Blood samples were obtained daily from the systemic part of the circuit and analysis showed normal values of pCO₂, between 5 and 7 kPa. In addition, analyses were regularly performed to assess plasma free hemoglobin (pHb), lactate dehydrogenase (LDH), fibrinogen, and D-dimer. The pHb was mostly below 0.04 g/dl (Figure 1), and LDH only showed a temporary rise, which indicated only brief periods of hemolysis. In addition, we regularly examined the ECMO circuit visually for any incipient clot formation in the tubing set or in the oxygenator. Any combined or unacceptable changes in these parameters would have necessitated changing the ECMO circuit. Anti-thrombin (AT) levels and blood platelet numbers were corrected during treatment with infusions of AT III (Atenativ 500 IE/KY, Octapharma AB, Stockholm, Sweden) and platelet transfusions.

Weekly echocardiography showed a well functioning left ventricle, pulmonary hypertension and a dilated right ventricle with moderate tricuspid insufficiency. The patient’s respiratory condition slightly improved after seven weeks of ECMO support. By the eighth week, platelet counts suddenly increased. At the same time, the activated partial thromboplastin time (APTT) decreased. The infusion of heparin (100 IU/ml) was increased to maintain the APTT above 50 sec. There were no ECMO-related complications observed. The air leaks gradually resolved and there was an improvement in lung function with larger tidal volumes (230-260 ml) and better gas exchange. To facilitate weaning, the patient received a low carbohydrate diet, as the main challenge was hypercapnia, not hypoxemia. ECMO support was gradually reduced to 50%. On the 52nd day, the patient experienced intrathoracic bleeding that required daily transfusions; this strengthened the need to wean the patient from ECMO.

By the 59th day, the patient was successfully decannulated and placed on conventional ventilation. Samples from the intrathoracic hematoma showed growth of Enterococcus faecalis, and this was treated with a course of Tazobactam and Ampicillin. The patient was supported with a ventilator for another 72 days. During this seven week period, he was gradually transferred to a mobile ventilator. He was decannulated after 131 days, but due to an infection, he had to be re cannulated 5 days later. He lost 20% of his initial body weight during the intensive care unit stay. He was discharged to the intensive care unit in the local hospital for further pulmonary rehabilitation.

Discussion

ECMO is a therapeutic option in severe ventilation or oxygenation failure problems that makes survival unlikely on conventional mechanical ventilation.

Figure 1 Levels of plasma-free hemoglobin during the period of ECMO support.
ECMO also inherently carries substantial hazards, specifically related to requirements for anticoagulation, the risk of sepsis, vascular and circuit disruptions, hemorrhage, infection, systemic embolization, and the need for circuit changes. ECMO is a time-limited procedure and most manufacturers do not advise more than 14 days of use.

Recently, the new, improved pumps, with coated circuits, have reduced the risk of hemolysis caused by centrifugal pumps. Moreover, plasma-leakage-resistant oxygenators have enabled the safe use of ECMO for much longer periods of time. The Quadrox PLS™ oxygenator used in our ECMO circuit was approved for 14 days of circulation. In this case, we were able to run this oxygenator for 59 days without any functional complications. To our knowledge, this was the longest perfusion reported with the same oxygenator.

The chances for survival with conventional ventilation were sufficiently low in this patient to justify any additional risks due to ECMO therapy. In spite of the prolonged conventional treatment, the patient suffered single organ failure only, with deteriorating lung function, high airway pressures and barotraumas. Ventilator-induced lung injury may cause renal failure, liver failure and cardiac failure. ECMO support may facilitate lung recovery by eliminating the problems of high pressure and high oxygen inherent in mechanical ventilation, thus, ECMO may increase the likelihood of survival, even in severe cases of ARDS.

References


