EXTRA CORPOREAL MEMBRANE OXYGENATION IN ACUTE RESPIRATORY DISTRESS SYNDROME

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Abstract

A young female presented with pneumonitis and worsened acute respiratory distress syndrome (ARDS) failed all the conservative ventilator management, was managed with extra corporeal life support technology, and was successfully discharged.

Keywords: Extra Corporeal Membrane Oxygenation (ECMO); Acute Respiratory Distress Syndrome (ARDS).

The Case

A 15 year old female, known case of chronic inflammatory demyelinating polyneuropathy, presented to emergency room (ER) on 02/01/2013 with chief complaints of shortness of breath, chest pain, fever, vomiting and diarrhea for 3 days. Her condition worsened in the ER due to respiratory distress, hypoxia and shock. Eventually she was intubated and mechanically ventilated. Post intubation chest x-ray (CXR) showed right upper zone pneumonia and she was shifted to intensive care unit (ICU) where she was managed with lung protective ventilation, antibiotics, antivirals and all other supportive critical care measures. Initial Ventilator settings were assist- pressure control mode with inspiratory pressure set between 26 - 30 cmH_2O, fraction of inspired oxygen (FiO_2) of 0.9, positive end expiratory pressure (PEEP) of 12 cmH20, respiratory frequency of 22 with an I:E of 1:2. Her ideal body weight (IBW) was 46 kg. Tidal volume generated was 160-200, which was just adequate. The patient was severely hypoxemic with oxygen saturation (SpO_2) of 85-88%. Arterial blood gas (ABG) reported P/F ratio of 90 with mild acidosis. Repeat CXR revealed worsening of right lung opacity and bronchoscopy was done to rule out any collapsed segment. Lung recruitment maneuvers with CPAP of 35 - 40 cmH_2O for 40 seconds were performed in view of recurrent severe oxygen desaturation and hypoxemia. The same management continued on 03/01/2013, and the frequency of recruitment maneuvers was increased. Recruitment maneuvers resulted in transient improvement of SpO_2. On 04/01/2013

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Chest X-rays

Fig. 1
02/01/2013- Initial CXR

Fig. 2
04/01/2013- Worsened CXR

Fig. 3
04/01/2013 CXR Post ECMO cannulation

Fig. 4
08/01/2013-CXR improving

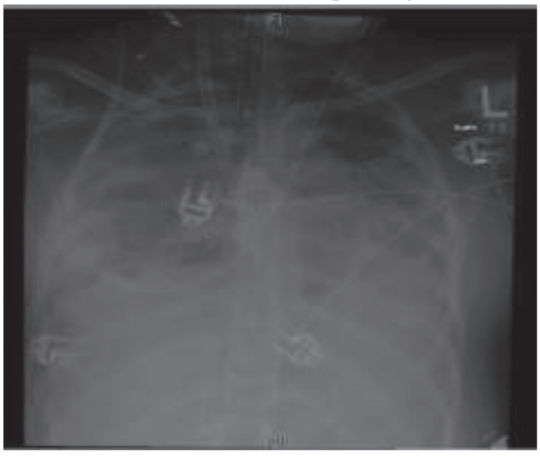
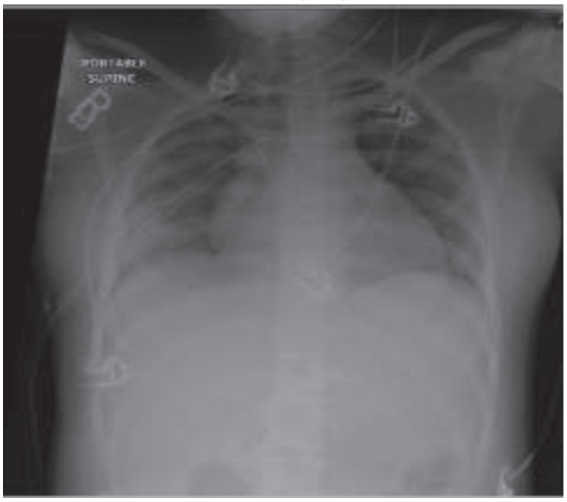


Fig. 5
14/01/2013-CXR, Post ECMO decannulation

Fig. 6
24/01/2013-CXR, 3 days after extubation



hypoxia and shock worsened and vasopressors were stepped up. CXR also worsened with bilateral infiltrates. High frequency oscillatory ventilation (HFOV) was initiated with FiO_2 of 1.0; Frequency of 6.0 Hz.; amplitude ensured adequate chest wiggle and continuous distending pressure (CDP) of 35 cmH_2O. In spite of this, hypoxemia was persistent. The patient suffered a cardiac arrest (pulseless electrical activity for 3 minutes, secondary to severe hypoxia) and was resuscitated. Mean arterial pressure (MAP) of >65 mmHg was achievable with maximal vasopressor support. All conventional lung protective strategy, recruitment maneuvers and HFOV failed to improve oxygenation. The decision to initiate Veno-Venous Extra Corporeal Membrane Oxygenation (VV ECMO) was made in view of severe refractory hypoxemia. The circuit was primed with crystalloid, plasma and heparin. The right internal jugular vein (Rt. IJV) was cannulated with 19F cannula and right femoral vein with 25F cannula. The cannulation procedure was uneventful. Settings were as follows: ECMO Flow: 4.5 to 5.5 LPM (120-150 ml/kg/min); Targeted ACT: 180-220 sec; FiO2: 100%; Sweep Gas: 4 LPM; Temperature: 36^0 C. The patient was kept on minimal ventilator settings with a minimal PEEP of 5 cmH_2O, low tidal volume (4-6 ml/kg IBW) and respiratory rate of 18. On 05/01/2013, patient's oxygenation status started to improve with stable hemodynamics, and subsequently the inotropic support was stepped down. Virology panels were negative for H_1N_1. There were no clear improvement in CXR and hence bronchoscopy was done again to rule out lung collapse. Infection control practices and nutritional support were strictly followed. On 08/1/2013, the CXR started to improve and Glasgow coma scale (GCS) was 9/15T. A pig tail catheter was inserted for right pleural effusion on 09/01/2013. The following days were uneventful with steady improvement in oxygenation. On 13/01/2013 morning, CXR revealed that Rt. IJV cannula was slipped out about 6 cm, and was reinserted with no adverse events. On 14/01/2013, weaning from ECMO was initiated, as the patient showed significant clinical improvements. CXR showed significant clearance of lung fields and patient was maintaining a SpO_2 of 95% on ECMO FiO_2 of 0.6, Arterial blood gas parameters were acceptable with a partial pressure of arterial oxygen (PaO_2) of 102 mmHg and a MAP of >80 mmHg with no vasopressors. On the morning of 15/01/2013, oxygen challenge test was performed. Ventilator FiO_2 was increased to 1.0 for 15 minutes and a subsequent ABG showed a PaO_2 of 180, which marked oxygen challenge test as satisfactorily positive. ECMO FiO_2 was decreased to 0.21 and eventually the ECMO machine was stopped and later the patient was decannulated. The patient was hemodynamically stable and maintained good oxygenation on minimal ventilator setting. The patient was successfully liberated and extubated on 21/01/2013 and post extubation phase was uneventful. On 04/02/2013, patient was shifted out to ward and rehabilitation phase was started. The patient was discharged home on 17/03/2013.

Discussion

There are many conservative adjuncts in treating patients with severe ARDS like recruitment maneuvers, prone positioning, aggressive diuresis, high frequency ventilation, shunt reduction techniques and extra corporeal life support as a last resort. ECMO is a re-evolving life support technology which has been in use for 40 years. There is a general consensus about the use of extra corporeal life support in neonatal and pediatric population with reversible cardiorespiratory failure[1]. The supportive evidence for its extensive use in adults has only emerged in the recent past, with the publication of the CESAR (Conventional ventilatory support vs extracorporeal membrane oxygenation for severe adult respiratory failure) trial[2] and a report of large number of H_1N_1 ARDS patients treated with ECMO[3]. Currently ECMO has become more reliable across the world with improved technology and increased experience, which has reflected in improved outcome. The Australian and CESAR studies suggest that ECMO can indeed save lives as a rescue therapy when conventional methods fail[2,3]. Of note ECMO can be considered as a supportive therapy rather than disease modifying treatment and best results are obtained if we choose the right patient, with the right mode and configuration at the right time.

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