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Case Study

# A 22 Year Old Female Case Scenario: Veno-venous Extracorporeal Membrane Oxygenation

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## I N F O

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## A B S T R A C T

ECMO (Extracorporeal membrane oxygenation) is one of the epic innovations of medical science to support the life of a human, in various conditions of lung failure, where it is difficult to maintain oxygenation of the body. ECMO was considered a very good option for conventional cardiopulmonary bypass technique and evolved into treatment of severe acute respiratory distress syndrome (ARDS) during the 1970s. Many kinds of research have been done on a similar topic. The initial reports on the utilisation of ECMO in ARDS patients were very exciting, and afterwards, ECMO proved to be certainly advantageous in infants having acute respiratory failure with a survival rate of almost 80%. There were two large randomised controlled trials, done during the period of 1979-1994 in adults with ARDS, that showed the failure of ECMO, with the survival rate range between 10% to 33%in the ECMO groups. Since then, ECMO treatment for ARDS patients has undergone further advancements by combining with lung-protective ventilation strategies and further by applying heparin-coated equipment, membranes, and tubings. Many healthcare facilities have used this advanced ECMO technology and achieved survival rates of more than 50%. However, whether improved ECMO can really challenge the advanced conventional treatment of adult ARDS is still a matter of debate and needs further studies.

It was seen that acute respiratory failure requires intensive care. In few cases where ventilator support doesn't prove effective, only the option of V-V ECMO remains. The present article describes the case of a 22-year-old female patient who was admitted with severe acute respiratory distress syndrome with associated multiple organ failure. The patient was admitted to the emergency of the Fortis Hospital with suspected acute kidney injury of unknown aetiology. After the initial 4 days of diagnostics at the ward, the patient required a further 24 days of hospital treatment and spent 16 days at the Intensive Care Unit. There, she underwent ECMO V-V therapy, lasting 14 days, which resulted initially in the improvement of his arterial blood gas parameters and clinical condition but later on, she developed pneumothorax and her condition worsened day by day gradually becoming critical.

**Keywords:** ECMO, Acute Respiratory Disease, V-V therapy

## Introduction

Extracorporeal membrane oxygenation (ECMO) is often used in adult patients with severe respiratory failure in the course of pneumonia of various aetiologies. This technique provides the patient's blood with oxygen and reduces hypercapnia until the lung tissue's ability to perform efficient gas exchange is restored. Extracorporeal membrane oxygenation is indicated if the aetiology of acute respiratory failure is reversible, which is not always known at the start of the therapy. The technique is complex and expensive; it requires the involvement of a qualified team and is burdened with the possibility of a number of complications, such as kidney failure, bacterial pneumonia, sepsis, or serious bleeding. Mortality can be almost 50%.[1] In this article, a case of unsuccessful ECMO V-V treatment used in a 22-year old patient with acute respiratory distress syndrome (ARDS) has been presented.

## Case Presentation

A 22-year-old lady, apparently well till a few days prior to admission on 7/11/2020 when she noticed yellow discolouration of palm and soles and had recurrent vomiting with abdominal pain. There was a history of taking Mobizox tablets for shoulder pain on and off for 8 months. On admission, she was found to have non-oliguric acute kidney injury and subsequently, due to increasing concentrations of creatinine (up to 10.20 mg/dl), renal replacement therapy was introduced, for which she was taken for emergency dialysis on 8/11/2020. A dialysis cannula was inserted into the right subclavian vein and continuous veno-venous hemofiltration was commenced. Her liver function showed hepatocellular jaundice with normal liver ultrasound. Her hepatitis B, hepatitis C IgM, Hep A andE were negative. She had a small pneumothorax which resolved spontaneously. Over the last few days, she was noticed to have fever, her renal function had improved and serum creatinine was 1.33. Inj. paracetamol 1 gm IV was given for fever and HRCT chest was done on 10/11/2020, which showed bilateral basal consolidation with ground glass opacity. The patient was admitted to the HCC-2 with progressive dyspnoea and increasing respiratory failure, raising the suspicion of pneumonia. Her condition was gradually deteriorating. Radiological examination revealed extensive bilateral shadowing on the lower lung fields. Decrease in oxygen saturation mandated the use of high flow mask. Her COVID-19 PCR and the repeat test were both negative. All culture reports done on 11/11/2020 detected no growth. Her renal function tests improved, liver function tests were stable with normal PT/INR. HRCT showed acute respiratory distress, and ABG showed a pH of 7.53 and a PCO2 of 38.9 on high flow mask.[3] She had a multiorgan involvement inabilities considered were Sepsis syndrome with multiorgan failure, blood and urine culture sent, procal 0.159, Topical infection – leptospira, falparium Malaria smear negative Systemic vasculitis ANA/C3/C4/ANCA, Influenza H1N1 – negative. She was on inj. meropenem, doxycycline, Andulfa with other supportive measures. Her potassium level fell on 12/11/2020, for which,inj. KCl 20 meq added in inj. PLASMA-LYTE was given, and anarterial line was inserted. On 14/11/2020, her Hb dropped to 7.7 gm. 1 unit PRBs was transfused and a pulmonologist review was done. Inj. targocid 400 mg IV BD followed by 400 mg OD was started (Figure 1).

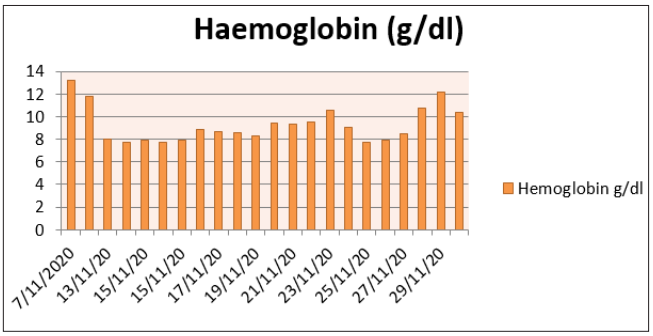


**Figure 1.Haemoglobin Lab Value Distribution of the Patient from 7/11/20 to 30/11/20**

On 15/11/20, 1 unit blood was transfused at 7:30 pm. Patient saturation fell and at 7:40 pm, she was intubated. Later on, she was catheterised and Ryles tube and central line were inserted. All ET culture, blood culture, and urine culture were sent. The patient was transferred to the intensive care unit (ICU) with the diagnosis of severe acute respiratory failure. The patient required deep sedation (fentanyl, tramadol, midazolam, propofol), and ventilation with the following ventilation parameters: volume control positive pressure, fraction of inspired oxygen (FiO2) 100%, positive end-expiratory pressure (PEEP) 5 cm H2O, and tidal volume 400 support. An improvement was achieved in terms of oxygen pressure in the arterial blood (PaO2 94 mmHg). Samples for microbiological analysis of the bronchial tree were collected. The viral, fungal, and bacterial analyses did not reveal any infectious microbe. Heart ultrasound examination showed normal cardiac structure, a dilated aorta, no valvular changes, and left ventricular ejection fraction (LVEF) of 60%. On 16/11/2020, the patient's respiratory function suddenly deteriorated – chest X-ray examination revealed an expansion of the inflammatory changes involving the lower and middle lobes of both lungs. Broncoscopy was done and a diagnosis of sepsis with multiorgan failure with a tropical/ viral aetiology was made. The patient was put in prone position once every 4 hours. A treatment employing meropenem, doxycycline, anidulafungin, targocid, polymyxin B, hydrocort 100 mg, and solmedrol was given but to no avail. Further examinations revealed the following: oxygen saturation 75.6%, pH in blood gas analysis (ABG) 7.48, partial pressure of carbon

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dioxide (PaCO2) 38.5 mmHg, and partial pressure of oxygen (PaO2) 41.9 mmHg.

The chest x-ray done on 17/11/20 did not show any improvement. On the second day in the ICU, ECMO V-V was started with 100% ventilatory support due to the growing signs of severe respiratory failure and increasing multi-organ hypoxia. Under general anaesthesia, cannulas were introduced into the right internal jugular vein (18 Fr) and the right femoral vein (22 Fr) using the Seldinger technique.6 Concurrently, heparin was administered in a continuous infusion of 2000-2800 units per hour, keeping the clotting time (activated clotting time – ACT) within the range of 130-148 seconds (Figure 2).

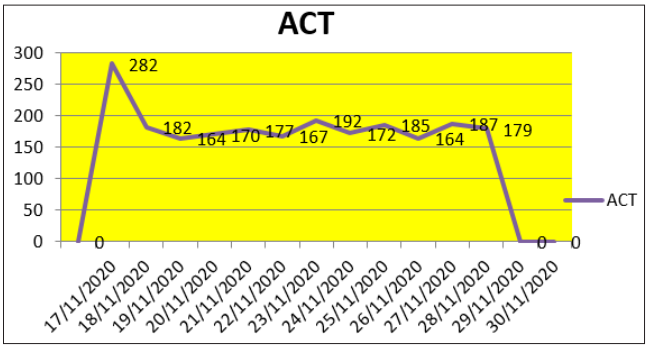


**Figure 2.ACT Value Distribution of the Patient on ECMO from 17/11/20 to 30/11/20**

Initially, the parameters of the ECMO oxygenator were set as follows: FiO2 90, blood flow 4 l/min, speed of the centrifugal pump 2875/min, and gas flow 1 l/min. Ultimately, the required gas flow was set at 6-8 l/min. An improvement of the ABG parameters (pH: 7.35, PaO2: 108 mmHg, PaCO2: 54 mmHg) was achieved. The ECMO therapy was continued with gas flow at 8 l/min and with 100% oxygen in the oxygenator, resulting in the achievement of a gradual improvement in terms of organ oxygenation as well as renal and hepatic function.

The respiratory function deteriorated again on18/11/2020. Chest X-ray revealed bilateral pneumothorax. Heparin treatment was terminated. Periodic norepinephrine infusion was required during drops in blood pressure. The patient received packed red blood cells, platelet-rich plasma, and fresh frozen plasma.

Chest computed tomography showed adhesions on the right side, fluid and pneumothorax along with minor changes on the left side, as well as extensive bilateral ground-glass opacities in the lung fields. The treatment involved stopping IV fluid, and giving RTF-100ml plus50ml protein powder. On 19/11/2020, inj. albumin, 20% was started at 15 ml/hr, and ET culture detected klebsiella pneumonia. On 21/11/20, the patient had 100 ºF temperature, and developed pneumothorax. On 24/11/2020, she required right pleural drainage and an ICD tube was inserted. Concomitantly, she was reported to have febrile episodes and an increased CVP. On 28/11/20, samples for culture were resent, and ICD tube was changed.USG chest revealed 150ml and 20 ml fluid on the right and left sides respectively. Blood count revealed an increased TLC (Figure3). The condition was assessed as critical and 4 units platelet and 1 unit PRBCs were transfused. ET culture detected stenotrophomonas maltophilia, while blood culture grew gram negative bacteria. On 29/11/20, the ET tube was changed, and conservative treatment was continued.

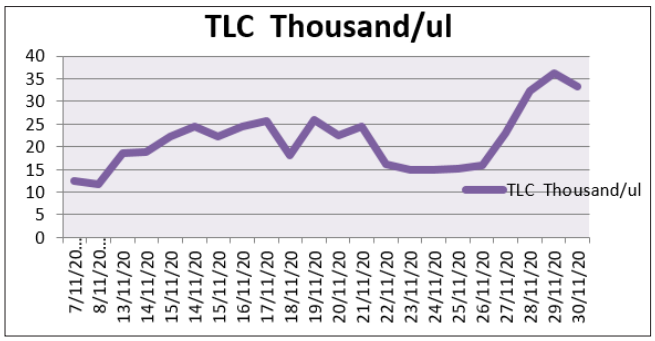


**Figure 3.TLC Lab Value Distribution of the Patient from 7/11/20 to 30/11/20**

On 30/11/2020, due to increased bleeding into the left pleural cavity throughout the period of hospitalisation (Figure 4), the patient required the transfusion of 20 units of packed red blood cells, 12 units of platelets, and 8 units of plasma. After 24 days, the patient had intermittent episodes of atrial flutter along with hypotension. Inotropes were started with high dose inj. Cordarone 150 mg stat andinfusion was started.AED paddles were attached and ECG was done. 200 ml of IV fluid was given for decreased urine output, following which, the patient suddenly developed arrhythmias and was declared dead on 30/11/20 at 10:50 pm.

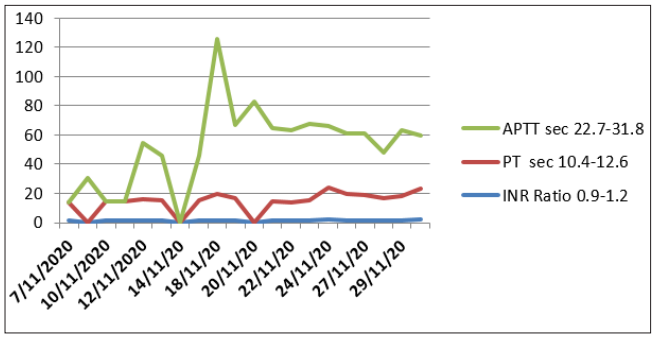


**Figure 4.Distribution of Coagulation Parameters of the Patient from 7/11/20 to 30/11/20**

## Discussion

In numerous cases, ECMO is an effective technique with a good chance of survival in cases where conservative treatment has not shown good result. Indications for V-V

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ECMO are respiratory disease due to sepsis, traumatic lung injury, lung failure, asthmatic state, and ARDS with oxygenation level (PaO2/ FiO2) < 70 mmHg. However, limitations to its use include the irreversibility of the pulmonary changes, the existence of potential bleeding source, preventing the use of heparin, and patient's refusal. ECMO has many complications associated with the patient's critical condition, damage of the pump, drains and dressings, clotting in the cannulas, drains and oxygenator, damage of the heat exchangers, air bubbles in the drains, accidental delinning and bleeding.[1] ECMO is not only very difficult to operate and monitor, but is also very costly,[2,4,5] Transporting a patient with ECMO equipment is an extremely difficult and tedious task. In this case, the medical team decided to use ECMO V-V in a 22-year-old patient with severe ARDS, with a goal to optimise a good remedial effect. To prevent bleeding complications without increasing the risk of ECMO clotting, a number of blood products such as red blood cell concentrates, platelet concentrates, plasma, and preparations of coagulation factors were administered, but no satisfactory results were achieved. In the presented case, no reasonable remedial impact of ECMO was seen because of complexity.[7]

## Conclusion

The use of early ECMO as compared to conventional mechanical ventilation alone in patients who had severe hypoxemia respiratory failure was associated with a lower risk of mortality and a longer length of stay with collaborative management and holistic care.[7] The ultimate goal of returning the patient to their normal life is not always possible as seen in the above discussed case. There is a demand for highly competent and expert nursing care for ECMO patients and there is a need for specialised nursing care for critically ill patients supported with ECMO.

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**Conflict of Interest:** None

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