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Extracorporeal membrane oxygenation for tuberculosis pneumonia with empyema

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ABSTRACT

Acute respiratory distress syndrome (ARDS) caused by *Mycobacterium Tuberculosis* (TB) is a rare entity. Extracorporeal membrane oxygenation (ECMO) therapy had been used as an effective therapy for this cases, but the evidence is scarce. We present a case that took place in the middle of SARS-CoV2 pandemic. A 33-year-old female presented with ARDS due to pulmonary TB infection (pneumonia with empyema and pneumothorax), which required invasive mechanical ventilation with poor response. Long term veno-arterio-venous (VAV) ECMO, overlapped with veno-venous ECMO, was used as a salvage therapy with a good response for a total of 26 days. This is an example of the effectiveness of this therapy in this scenario, never described before. The fact that this therapy was used in the middle of SARS-CoV2 pandemic, with limited resources available, was remarkable, but it was encouraged by previous successful experiences.

1. Introduction

Acute respiratory distress syndrome (ARDS) caused by *Mycobacterium Tuberculosis* (TB) is a rare entity, corresponding to 4.9 % in a cohort of patients with ARDS [1]. However, a high mortality rate (60–70 %) has been described in those who require invasive mechanical ventilation (IMV) [2,3]. The presence of hyponatremia, a PAO_2/FiO_2 ratio lower than 108.5, APACHE II score of more than 18, the presence of multiorgan-failure and consolidation images on X-Rays are described as high mortality risk factors [3,4]. On the other hand, female sex and a higher PaO_2/FiO_2 ratio are associated with a better prognosis [5].

There is evidence of the successful use of extracorporeal membrane oxygenation (ECMO) in the context of influenza A (H1N1) pneumonia [6,7]. Accordingly, ECMO has been used as therapy for ARDS due to TB. However, published evidence is scarce, with only 12 cases published to our knowledge [2,8–18]. We present a case of a patient with ARDS secondary to TB in whom ECMO was used as a salvage therapy in the middle of SARS-CoV-2 pandemic.

2. Case report

A 33-year-old female, homeless, with a history of type 2 diabetes, tabaquism and no previous history of lung disease was admitted with a 10-day history of cough, expectoration and progressive dyspnea. SARS-CoV2 infection was ruled out. Chest X-Ray showed bilateral pleural effusion, left tension pneumothorax and tuberculous cavities in the right lung (Fig. 1). A left chest tube (CT) was installed with little improvement in hemodynamics, requiring high-dose vasoactive drugs and IMV. Antibiotic therapy with Vancomycin 1 gr. b.i.d. And Meropenem 1 gr. t.i.d was empirically initiated. Work-up was continued with HIV antibodies testing that was negative. GeneXpert PCR on endotracheal aspirate was positive for TB, with no resistance for rifampicin. Thus, treatment with rifampicin 600 mg/day, isoniazid 300 mg/day, ethambutol 800 mg/day and pyrazinamide 1.5 g/day was initiated. The patient was transferred in this condition to our center to continue her treatment. Upon admission in our hospital, APACHE II score was 17 and PaO_2/FiO_2 ratio was 65. No other organ disfunction was present at that moment. Due to persistent pneumothorax and air leak, two new CTs were installed upon arrival. The pleural fluid study was compatible with

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empyema secondary to TB. Despite CTs, she remained unstable with high dose vasoactive drugs (VAD) (norepinephrine 0.8 mcg/kg/min, epinephrine 0,05 mcg/kg/min), with refractory hypoxemia (PaO_2/FiO_2 = 60) and a lung protective strategy could not be maintained. Bronchopleural fistula hindered IMV as well. In this context, she was connected to femoro-femoral veno-arterial ECMO (VA-ECMO) given her hemodynamics. After ECMO flow initiation, an oxygen saturation of 50 % in the right upper extremity and 100 % in the left upper extremity evidenced a Harlequin Syndrome, so it was converted to veno-arterio-venous (VAV) mode adding a right internal jugular cannula (Fig. 2). She required an embolectomy of the leg 12 hours after ECMO initiation after thrombosis was found in the distal arterial perfusion line. Activated clotting time was adjusted to 200–220 seconds with no further thrombotic issues. On day 4 of VAV-ECMO, VAD were suspended and ECMO was then converted to veno-venous (VV-ECMO), maintaining the right internal jugular for oxygenated blood return and femoral venous cannula for drainage and removing arterial cannulas. Due to persistent pneumothorax a left pleural decortication and fistula repair with an intercostal muscle flap was then successfully done. After 26 days on ECMO, she was weaned from support with good lung re-expansion. A week after a tracheostomy was performed. She was weaned from ventilatory support 2 weeks later. She was discharged home with in-house rehabilitation therapy 20 weeks after admission.

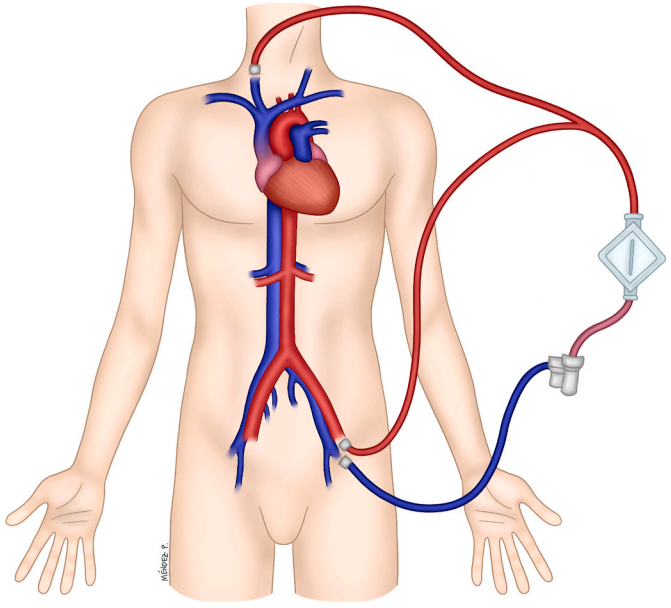

Fig. 2. Schematization of VAV-ECMO strategy.
Description: Venous blood flows from femoral vein into the pump and then it returns as arterialized blood into the femoral artery and into the right internal jugular vein, stablishing a VAV-ECMO circuit.

3. Discussion

ARDS secondary to TB is a rare entity with high mortality [2,3]. The evidence of ECMO support in these cases is scarce and is only in the form of case reports. However, the experience had been positive, with 11/12 cases with good results [2,8–15,17,18], with the non-recovered patient being a case where TB was diagnosed post mortem [16]. Most of these cases used VV-ECMO, with VA-ECMO reserved for concomitant cardiologic involvement [15]. A novel aspect of this case is that the initial modality was VAV-ECMO because of hemodynamic compromise and the development of Harlequin Syndrome. This is a described complication of VA-ECMO, produced by a preserved or recovering heart function combined with a poor lung function, so the native desaturated cardiac output flows against the well oxygenated retrograde pumped blood. Thus, the heart and upper body receives poorly oxygenated blood. This is solved using the described VAV configuration, which combines a VV and a VA ECMO [19]. After patient hemodynamics recovered and no

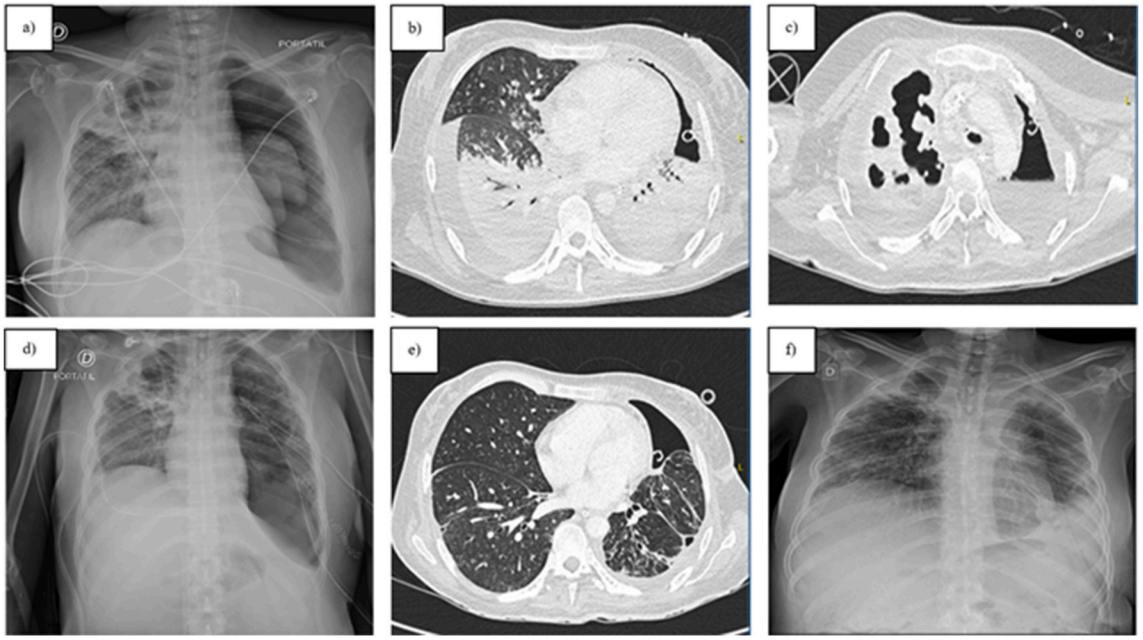

Fig. 1. Radiological follow up of the patient
A): Chest X-Ray on the day of admission previous to left decortication: Left-tension pneumothorax despite chest tube, tuberculous cavities on the right lung and bilateral pleural effusion. **B and C)** Chest computed tomography upon 7 days from admission, previous to left decortication: Right superior lobe extensive pulmonary cavitation with right bud tree micronodules. Left loculated hydropneumothorax with a left chest tube and right pleural effusion. **D)** Chest X Ray on day 1 post left pleural decortication and fistula repair. **E)** Chest computed tomography 6 weeks after left pleural decortication and fistula repair: Complete re-expansion of the right lung, resolution of right pleural effusion with partial left pulmonary re-expansion and persistence of the left hydropneumothorax with decrease of the signs of diffuse bronchiolitis. **F)** Chest X-Ray 4 months post-surgery: Small left pleural effusion, lung re-expansion.

support was needed, modifying to VV-ECMO was a very simple procedure given the initial VAV configuration (Fig. 2). Complications of ECMO include kidney injury requiring hemofiltration (52 %), bleeding (33 %), sepsis (26 %), hemolysis (18 %), liver failure (16 %), lower extremity ischemia (10 %) and venous thrombosis (10 %) among others [20]. In this case, femoral artery thrombosis was successfully treated with no other major complications. The duration of ECMO in reported cases was generally prolonged. This was also the case in this report, with a total duration of 26 days. Good outcomes have now been reported with the use of ECMO for more than 14 days for severe respiratory failure, with a survival up to 45 % [21]. This is lower than survival for short-time ECMO, but significantly higher than the reported in previous decades [21].

It is remarkable that this case took place in the middle of Covid-19 pandemic. Despite limited availability of pumps (because a great number of Covid-19 patients were on ECMO support) we decided to proceed given the good results on the published reports, which included a case of our own in 2012 [12].

In conclusion, the use of ECMO is an effective alternative for treatment of ARDS secondary to TB, the VAV modality being effective in patients who are also hemodynamically compromised; the use of ECMO for prolonged periods appears to be effective in these patients.

Author contribution

SB, AJM, PS, SBM and LGO all had made substantial contributions to the conception and design of the work. They all contributed to the acquisition, analysis and interpretation of the data. They all participated on the drafting, critical revision and final approval of the version to be published. They all agree to be accountable for all aspects of the work. Other Contributions: We sincerely thank Magdalena Méndez M.D. for the creation of the VAV-ECMO scheme.

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Declaration of competing interest

None.

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