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LETTER

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Veno-venous ECMO in ARDS after post-traumatic pneumonectomy

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Dear Editor,

Post-traumatic pneumonectomy is rare, but burdened by high mortality (50–80 %) and high morbidity, with a complication rate of >85 %, most commonly pneumonia and respiratory failure [1]. Life-threatening acute respiratory distress syndrome (ARDS) can develop, and the worst outcome is associated with right pneumonectomy [2].

Extracorporeal membrane oxygenation (ECMO) is a rescue option in ARDS that allows for protective mechanical ventilation and potentially less ventilator-induced damage [3]. In the past, trauma cases requiring anticoagulation for ECMO implantation posed a clinical dilemma that has now been partially overcome with the advent of latest generation devices. We report a case of multifactorial ARDS (pneumonia, polytransfusion, and fluid overload) after right pneumonectomy due to blunt chest trauma in which the patient was non-responsive to protective ventilation and conventional therapy [4]. The patient survived with early implantation and 29 days of ECMO support.

A 25-year-old male (170 cm, 61 kg) was admitted to another facility with major blunt thoracic trauma causing right hemothorax, right main bronchial disruption, left pneumothorax, and pneumomediastinum. Surgical treatment consisted of right pneumonectomy, left chest drainage, and tracheostomy. Despite lung-protective ventilation, the patient developed ARDS, with hypoxic–hypercapnic respiratory failure [partial pressure of oxygen in arterial blood/fraction of inspired oxygen (PaO_2/FiO_2) 40 at 36 h]. A PaO_2/FiO_2 ratio of <100 with a FiO_2 of 1.0 for more than 6 h indicates that a patient has a >80 % risk of death (Extracorporeal Life Support Organization guidelines) (Fig. 1).

The referring center requested a consultation, and despite the recent trauma and surgery, we decided to start the patient on veno-venous ECMO (VV-ECMO) which achieved stabilization and allowed the patient to be safely transported about 200 km by helicopter to our institute. Vessel cannulation [18 Fr return (jugular) and 24 Fr drainage (femoral)] was performed after the administration of a heparin bolus (80 IU/kg). VV-ECMO support (miniaturized tip-to-tip heparin-coated circuit; Cardiohelp System; Maquet, Rastatt, Germany) was initiated, with the initial goal of achieving a blood flow of about 4 l/min (3,000 rpm and 2 l/min of sweep gas flow) in order to provide maximal oxygenation support, but avoid iatrogenic alkalosis. Protective mechanical ventilation for transport was a FiO_2 of 40 %, peak inspiratory pressure (PIP) of 20 cm H_2O, positive end-expiratory pressure (PEEP) of 10 cm H_2O, and respiratory rate (RR) of 10 breaths/min (Oxylog 3000 Plus; Draeger, Menlo Park, CA).

On arrival at our institute, after a few hours of ECMO, gas exchange parameters were adequate (pH 7.34, PaO_2 116 mmHg, $PaCO_2$ 58 mmHg). Microbiological screening revealed colonization by *Acinetobacter baumannii* (multi-drug resistant), which was confirmed by the swab test and bronchoalveolar lavage. Continuous heparin infusion was initiated to maintain an activated partial thromboplastin time of 40–50 s, and an

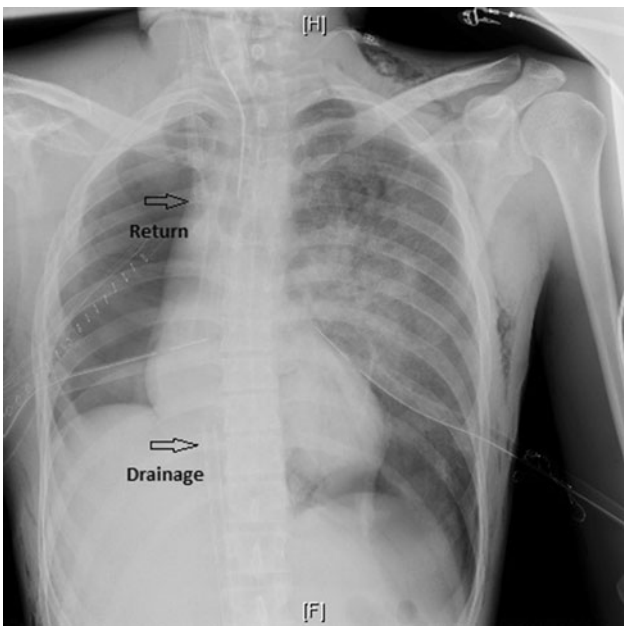

Fig. 1 Chest X-Ray post-pneumonectomy at arrival in ISMETT. ECMO Cannulation

antithrombin level of approximately 100 %. No relevant bleeding occurred in the course of the ECMO support.

After about 12 days the patient experienced a severe septic shock, which was treated by completely changing the ECMO circuit (15 day) and central line and initiating targeted antibiotic therapy. The mechanical ventilation setting was adjusted to minimize ventilator-induced lung injury. For the first 15 days we employed pressure controlled ventilation [FiO_2 30 %, PIP 20, PEEP 10, inspiration time (Tinsp) 2 s, RR 10/min], adapting the patient through deep sedation and, for the first days, also through paralysis, with full support provided by a membrane lung for oxygenation and CO_2 removal. The tidal volume was extremely low, with a maximum of 100 ml, which worsened with the septic shock. Because there was no improvement after 2 weeks, we started the patient on pronation, and on day 20 we detected a slight but progressive improvement in oxygenation and volumes (approx. 150 ml) obtained by ventilation; however, there was still a need to include several pressure-controlled breaths in the treatment regimen to protect against tachypnea. At this point we were able to progressively reduce the sweep gas flow in the membrane, switching ventilation to pressure support ventilation (PSV; PEEP 8 cmH_2O, PS 16 → 10, RRspont ~28), with 1/2 recruiting breaths per minute and recruiting maneuvers by airway pressure release ventilation several times a day. After 29 days we obtained adequate lung function, sustained solely by ventilator in the PSV mode. The patient was then successfully weaned from ECMO. Weaning from ventilation with track collar mask cycles combined with PSV as recruiting was completed 8 days later, and the patient was discharged from the Intensive Care Unit with O_2-therapy by track mask, able to walk and feed himself.

In our patient, lung rest ventilation together with antibiotic therapy, adequate fluid balance, and optimization of ventilation distribution by prone positioning were central in achieving recovery of pulmonary function. Adequate and combined sedation and treatment of the subsequent withdrawal syndrome, full enteral nutritional support whenever possible, and frequent physical therapy from admission onward were also of paramount importance for the survival of this patient.

Although clearcut indications for VV-ECMO for ARDS in adults are incomplete, it seems reasonable to employ this technique in patients at a >80 % risk of mortality from respiratory failure [3]. There is an ongoing debate over both the timing and duration of ECMO, and reports of long-term support for patients suffering from severe ARDS are sporadic. Mortality rates in ARDS are high, and for nonresponders to protective ventilation the early initiation of ECMO support can be lifesaving, even in trauma cases. As was done during the H1N1 influenza pandemic, the possibility of centralizing such patients in specialized centers is likely to be key for successful recovery [5].

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Conflicts of interest None.

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