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Case report

Acute respiratory distress syndrome due to severe pulmonary tuberculosis treated with extracorporeal membrane oxygenation: A case report and review of the literature

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ABSTRACT

Mortality in patients with pulmonary tuberculosis remains high, especially in those who develop acute respiratory distress syndrome (ARDS). We report on a-48-year-old man with ARDS due to severe pulmonary tuberculosis who was rescued by extracorporeal membrane oxygenation (ECMO). He was initially hospitalized in the intensive care unit and noninvasive positive-pressure ventilation started. He was also administered anti-tuberculosis drugs and received systemic corticosteroid therapy. Six days later, further deterioration of gas exchange prompted the decision to intubate. However, he experienced progressive deterioration of arterial oxygenation despite conventional ventilatory support. We therefore decided to administer ECMO on day 9. After initiation of these treatments and ECMO support, pulmonary infiltrate and oxygenation status gradually improved and ECMO was discontinued on day 52. The patient was finally discharged from our hospital without severe disability. ECMO should be considered one of the treatment options for the management of ARDS due to severe pulmonary tuberculosis.

1. Introduction

In-hospital mortality of tuberculosis patients remains high, especially among those requiring admission to the intensive care unit (ICU) and mechanical ventilation (MV) [1,2]. Tuberculosis patients requiring ICU care may also develop acute respiratory distress syndrome (ARDS) [1,3]. In the management of patients with ARDS, extracorporeal membrane oxygenation (ECMO) has been successfully used as salvage therapy. ARDS severe enough to require ECMO support is estimated to occur in nearly 5 to 10 cases per million population per year [4]. The effectiveness of ECMO in ARDS patients with pneumonia, influenza A (H1N1) and trauma has recently been described but is less certain in ARDS patients with pulmonary tuberculosis (PTB) [5,6]. We report a patient with ARDS due to severe PTB who was rescued by ECMO.

2. Case report

A-48-year-old man was admitted to our hospital because of dyspnea. His sputa were strongly smear-positive and the mycobacteria obtained from culture were identified as *Miliary tuberculosis*. Routine blood tests showed white blood cell count of 12800/mm^3, platelets of 35.0 × 10^4/mm^3, C-reactive protein of 22.0 mg/dl, albumin level of 1.9 g/dl and a negative HIV ELISA test. His chest X-ray and computed tomography showed diffuse bilateral infiltration and cavity (Fig. 1A, B), and blood gas test showed PaO_2/FiO_2 131.0. This patient was initially hospitalized in the ICU and noninvasive positive-pressure ventilation started. Anti-tuberculosis drugs,

Abbreviations: ARDS, acute respiratory distress syndrome; ECMO, extracorporeal membrane oxygenation; ICU, intensive care unit; MV, mechanical ventilation; PTB, pulmonary tuberculosis.

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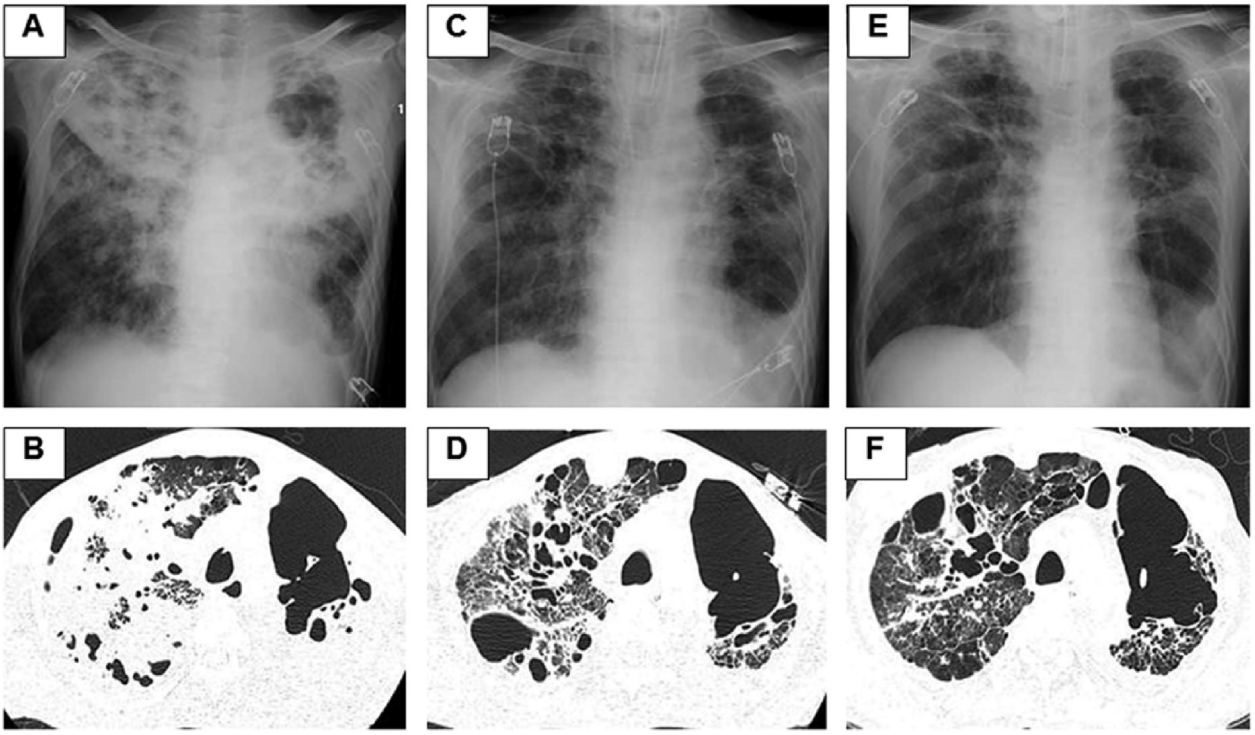

Fig. 1. Chest X-ray and computed tomography images. (A) and (B): On the day of admission to our hospital. (C) and (D): 3 days after the discontinuation of extracorporeal membrane oxygenation. (E) and (F): 2 weeks after weaning from mechanical ventilation.

including isoniazid, refampicin, streptomycin and pyrazinamide; antibiotics including meropenem and ciprofloxacin; and intravenous methylprednisolone (1.0 mg/kg/day) were introduced.

Six days later, further deterioration of gas exchange prompted the decision to intubate and steroid pulse therapy consisting of intravenous methylprednisolone (1000 mg/day for 3 days) followed by intravenous methylprednisolone (1.0 mg/kg/day) was administered. However, on the 3rd day of intubation arterial blood gas analyses showed severe hypoxemia (PaO_2/FiO_2 60.4) refractory to conventional MV, and we decided to administer veno-venous ECMO. Ventilator settings were adjusted to provide lung rest (pressure controlled ventilation with peak pressure of 20 cmH_2O, PEEP of 10 cmH_2O, and ventilation frequency of 8 per minute).

Hemoptysis was observed on day 27 after the start of ECMO but ceased with adjustment to a lower dosage of heparin. No other ECMO-related major complications were evident during treatment. The pulmonary infiltrate and oxygenation status gradually improved (Fig. 1C, D, E, F), and the systemic corticosteroid was tapered. ECMO was discontinued on day 52 and we successfully weaned the patient from MV 106 days after the start of administration of ECMO. After a hospital stay and rehabilitation of 10 months, he was discharged from our hospital without severe disability.

3. Discussion

ECMO is considered one of the treatment options for severe ARDS [5–7]. ARDS is an infrequent but serious complication of PTB [8]. The mortality of ARDS patients with PTB requiring MV is relatively high compared with that of patients with ARDS from other causes [9]. Five patients with acute respiratory failure due to PTB were recently reported to be successfully rescued by ECMO [10–15] (Table 1). Given the high mortality rate of ARDS patients with PTB, ECMO could be an important treatment option.

An innovative aspect of this case is the duration of ECMO, which was longer than that in ARDS from other causes. The clinical courses of patients with PTB often become indolent and the healing rate of PTB is characteristically slow. In addition, our patient showed severe hypoxia compared with previous patients with ARDS from PTB treated with MV [9]. A previous study reported that PTB patients with greater disease extent and severity showed persistent inflammation and required longer treatment [16]. While there is some concern that long-term use of ECMO may lead to a higher risk of complications, recent progress in the techniques and equipment used in ECMO have made prolonged ECMO support feasible. In fact, the survival of prolonged ECMO patients has improved significantly compared with previous years [17]. Another

Table 1
Previously reported patients with pulmonary tuberculosis treated with ECMO.

Age	Sex	Underlying condition	Treatment	Use of corticosteroid	Length of ECMO	Outcome	Author/year
58	F	None	None	None	5 days	Death	Homan W 1975 [10]
15	F	None	INH/RFP/EB/PZA	None	6 days (152 h)	Recovery	Petrillo TM 2001 [11]
20	M	None	INH/RFP/EB/PZA	None	89 days	Recovery	Mauri T 2012 [12]
14	F	Histiocytic hemophagocytosis	INH/RFP/EB/PZA	Methylprednisolone 2mg/kg/day	6 days	recovery	Monier B 2013 [13]
24	F	Laryngeal papilloma	INH/RFP/EB/PZA	Methylprednisolone 250mg/day	36 days	Recovery	Andresen M 2013 [14]
20	M	None	INH/RFP/EB/PZA	None	89 days	Recovery	Cogliandro V 2014 [15]

EB = ethambutol; ECMO = extracorporeal membrane oxygenation; INH = isoniazid; PZA = pyrazinamide; RFP = refampicin.

report supporting this described a case of indolent infection caused by *Nocardia cyriacigeorgica* and *Burkholderia cepacia* that was rescued by ECMO [18].

In this patient the adjunctive use of systemic corticosteroid therapy led to rapid clinical improvement and allowed us to wean the patient off ECMO earlier. Andresen et al. similarly reported that systemic corticosteroid therapy during ECMO support led to progressive improvement of respiratory function [14]. Several other studies have also suggested the effectiveness of adjunctive use of corticosteroids for PTB [19–21]. The steroid dose we used in this case was higher than that in the previous reports. Although evidence for high dose steroid therapy for PTB is still lacking, our aim in using this high dose was to get quicker and stronger results and to decrease the need for long-term steroid use [22].

In conclusion, we have reported here a patient with ARDS due to severe PTB who was rescued by ECMO. The healing rate of PTB is characteristically slow, which may lead the long-term use of ECMO. There is increasing recent evidence for the effectiveness of ECMO, and advances in the techniques and devices have made prolonged ECMO support feasible. ECMO should therefore be considered among the treatment options in patients with ARDS due to severe PTB when conventional ventilatory support is inadequate.

Financial disclosure and conflicts of interest

All of the authors confirm that there are no known conflicts of interest associated with this publication and there has been no significant financial support for this work that could have influenced its outcome.

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