

## One Hundred Seven Days of ECMO as a Bridge to Lung Transplantation: The Longest Duration Among Elderly Patients

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Extracorporeal membrane oxygenation (ECMO) is a means for supporting adequate gas exchange in patients with severe respiratory failure and is the only therapeutic option for ventilation-refractory patients awaiting lung transplantation. Moreover, defining the patients likely to benefit from ECMO as a bridge to transplantation has recently become a point of interest. Here, we report a case of prolonged ECMO support to a patient awaiting lung transplantation. A 66-year-old woman was diagnosed with acute interstitial pneumonia and was placed on veno-venous (VV) ECMO due to unsatisfactory gas exchange despite maximal ventilator care. She underwent bilateral lung transplantation after 99 days of ECMO and was successfully weaned from it on the 107th ECMO day. This is the longest period of ECMO support to be reported among elderly patients.

**Key Words:** extracorporeal membrane oxygenation; lung transplantation; respiratory insufficiency.

Extracorporeal membrane oxygenation (ECMO) is the only therapeutic method for patients with end stage pulmonary disease and for those waiting for lung transplantation. Due to negative outcomes reported by previous studies, ECMO has been considered to be a contraindication for patients waiting for future lung transplantation.[1,2] However, developments in techniques and devices have not only enabled patients to benefit from ECMO, but also have led to decreases in the risk of bleeding and lung injury from prolonged mechanical ventilation.[3] Accordingly, the role of ECMO as a bridge to lung transplantation has garnered greater interest in the field of transplantation, especially for ventilation-refractory patients.[4,5] Several studies have reported on ECMO as a bridge to lung transplantation, yet most of them deal with relatively young patients of less than 50

years old.[6] Herein, we report our experience of 107 days of ECMO as a bridge to lung transplantation in an elderly patient with acute interstitial pneumonia.

### CASE REPORT

A 66-year-old woman, who presented with 40 days of dyspnea, cough, and sputum, was diagnosed with acute interstitial pneumonia. She had previous medical history of hypertension and fatty liver disease. She was admitted to the intensive care unit and began receiving mechanical ventilation (Fig. 1a). Conventional ventilator techniques were applied in an effort to prevent severe hypoxia and inefficient gas exchange. She was placed on veno-venous (VV) ECMO: the use of ECMO partially corrected the abnormal gas status. Despite such improvements, she could not be weaned from ECMO, and her condition still was not stabilized (Fig. 1b). Therefore, lung transplantation became her only therapeutic option. After 105 days on the ventilator, or 99 days of ECMO support, she underwent bilateral lung transplantation (Fig. 2). She was changed to veno-arterial (VA) ECMO prior to surgery in case of unexpected hemodynamic instability caused by surgical manipulation. This was maintained until postoperative day 1

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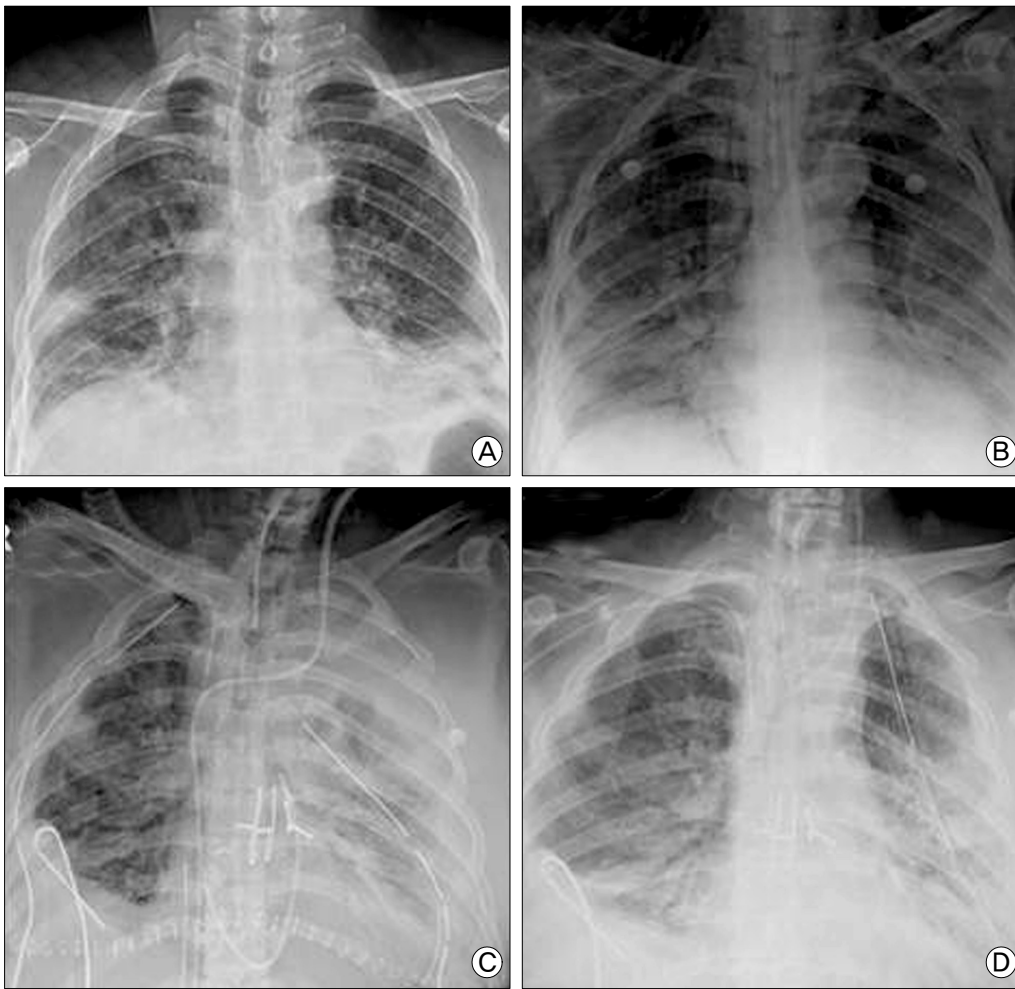
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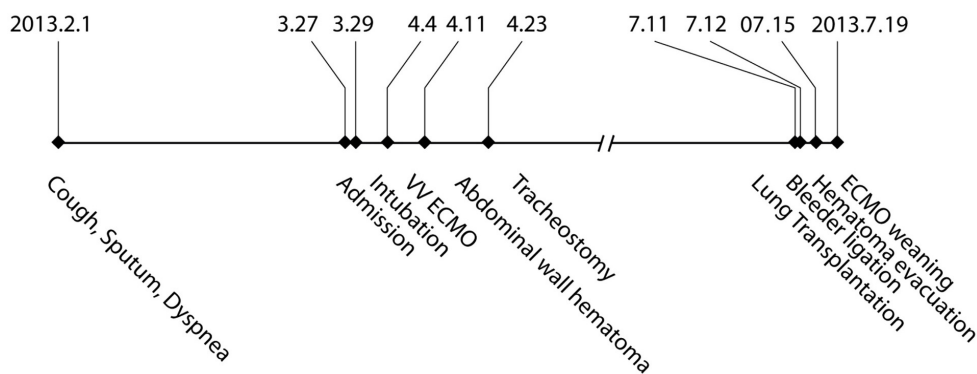
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**Fig. 1.** Chest radiography at (A) 40 days after onset of symptoms prior to intubation; (B) Progression of patchy opacity in both lungs on day 1 of ECMO; (C) Improved right pneumonic consolidation, but still noted haziness on left lung due to hematoma on postoperative day 4 of bilateral lung transplantation; (D) Resolution of bilateral consolidation on day 14 of surgery.



**Fig. 2.** Timeline of major clinical events.

when she underwent bleeder ligation and hematoma removal due to arterial bleeding in her chest cavity. The operation was uneventful and she tolerated well with the veno-veno (VV) ECMO. On postoperative day 4, she underwent evacuation of hematoma in her thoracic cavity (Fig. 1c).

Complications during the 107 days of ECMO included spontaneous abdominal wall hematoma on the 7th day of ECMO,

probably due to the use of heparin. Heparinization was stopped on postoperative day 4 due to concern about bleeding risk and hematoma formation on her chest. The patient was weaned from the ECMO on the postoperative day 8. During the 107 days of ECMO support, four oxygenators were replaced. Pathologic examination showed interstitial fibrosis with fibrinous exudates. The postoperative course was complicated by possible pulmo-

nary infections, sepsis, and profound critical illness myopathy, leading to delayed weaning from the ventilator despite proper rehabilitation and physical therapy. Other complications included newly applied hemodialysis due to decreased renal function, and pressure-sores along coccyx area due to prolonged immobilization. She is still undergoing respiratory rehabilitation and is working to be weaned from the ventilator (Fig. 1d).

## DISCUSSION

Although there have been many efforts to resolve organ shortages, finding a suitable donor is difficult, especially for those needing a lung transplantation. While new surgical techniques, such as lobar lung transplantation, are being introduced,[7] scarcity of available donor organs reflects an imbalance in supply and demand. Such shortages of donor lungs have necessitated the introduction of ECMO as a bridge to lung transplantation for end stage pulmonary disease patients.

ECMO has been widely adopted for patients with respiratory failure to assist adequate gas exchange. Nowadays, many physicians focus on ECMO not only as a gas exchanger, but also as a bridge to lung transplantation. In patients with chronic respiratory failure and limitations in gas exchange, despite mechanical ventilation aid, lung transplantation could be the only available treatment measure. However, ECMO had been regarded as a contraindication for lung transplantation due to a multivariate risk analysis conducted by the United Network for Organ Sharing (UNOS), which indicated both mechanical ventilation and ECMO before lung transplantation as strong predictors of death.[2] The role of ECMO as a bridge to lung transplantation has recently come into the spotlight due to advancements in ECMO systems.[8]

Previously, the longest period reported to be supported by ECMO was 57 days,[9] while recent studies with advanced ECMO systems have reported 107 and 110 days.[10,11] One case ended the support followed by lung transplantation, while the other ended upon recuperation from the disease. Our report describes a 66-year old woman with acute interstitial pneumonia who had been on ECMO due to inadequate gas exchange with mechanical ventilation, and had received lung transplantation. The patient could not be weaned off immediately after surgery despite bilateral lung transplantation, but was off ECMO support by postoperative day 8. Although the patient could not be weaned off at once after the operation and remained on ventilator support, our case is of importance because the maintenance of ECMO support was the longest reported among elderly patients.

Despite adequate respiratory support by ECMO, many patients undergoing lung transplantation, especially elderly patients, face many other clinical issues. Adequate muscle strength is needed not only for successful postoperative rehabilitation and ventilator weaning, but also for overcoming acquired neuromuscular disorders, such as critical illness myopathy, which are common among patients receiving prolonged mechanical ventilation.[12,13] Elderly patients may also already have deteriorated physical conditions preoperatively. Bleeding tendency due to the use of heparin for operating ECMO and decreased renal function are other clinical issues that warrant concern in patients on prolonged ECMO.

Although our patient is still on mechanical ventilation, we found our experience to be worthy of reporting not only for accepting ECMO as a bridge to lung transplantation, but also for determining patients in whom to apply ECMO. The role of ECMO as a bridge to lung transplantation has already been acknowledged by many physicians. Nevertheless, due to conflicting results regarding to patient outcomes with ECMO, many study groups now focus on specifying which patients can be expected to benefit from ECMO as a bridge.[13]

In conclusion, we reported our educational experience with lung transplantation in a patient supported by a prolonged period of ECMO, the longest so far among elderly patients. We believe our experience can help supplement future clinical decisions in determining which patients may benefit from ECMO.

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