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Case Report

A Case of Early Initiation of Veno-venous Extracorporeal Membrane Oxygen in Morbid Obesity with Severe Legionella Pneumonia

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Abstract: We present a case of a critically ill patient with severe Legionella pneumonia complicated by morbid obesity (BMI ≥ 40 kg/m^2) who was successfully treated with early initiation of veno-venous ECMO (V-V-ECMO) without any sequelae. The patient, a 48-year-old male, initially presented with symptoms of a sore throat, fever, significant fatigue, and decreased appetite. Upon diagnosis of severe pneumonia complicated by morbid obesity, he was transferred to our hospital for further management. Upon admission, he was promptly intubated and placed on mechanical ventilation. Due to a positive urinary Legionella antigen test indicating a risk of deterioration, V-V ECMO was initiated immediately after intubation. During ECMO support, the patient received Levofloxacin Hydrate at 500 mg/day and Prednisolone Sodium Succinate at 100 mg/day. He was successfully weaned off ECMO after 12 days and transferred back to the referring hospital on day 20. While ECMO therapy for morbidly obese patients was traditionally considered relatively contraindicated, this case suggest that obesity alone is not a contraindication to initiating ECMO.

Keywords: Legionella pneumophila, V-V ECMO (veno-venous extracorporeal membrane oxygenation), Morbid Obesity

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1. Introduction

Legionella pneumonia caused by *Legionella* species infection is estimated to account for about 2-15% of community-acquired pneumonia (CAP) [1]. Legionella pneumonia is highly associated with severe respiratory failure and can lead to acute respiratory distress syndrome (ARDS) [2]. Some authors have reported a mortality of 33% in patients with Legionella infection who required intensive care [3]. Therefore, in recent years, ECMO (extracorporeal membrane oxygenation) has been introduced for patients with Legionella related severe respiratory failure, and the survival of 84% has been reported [4]. This time we experienced a case of severe Legionella pneumonia patient with morbid obesity (BMI ≧40 kg/m^2) who was successfully rescued without any sequelae by early initiation of V-V ECMO (veno-venous ECMO). Based on our experience, we discussed and reported on the indications for ECMO in patients with morbid obesity.

2. Case Report

A 48-year-old male with no recent travel history and a history of type 2 diabetes presented with sore throat and fever 7 days before admission to our hospital. COVID-19 antigen and influenza virus antigen tests at a nearby medical facility were negative. Subsequently, he developed significant fatigue and loss of appetite, and a chest X-ray showed infiltrative shadows mainly in the right lower lung field at the referring hospital. They found it difficult to manage tracheal intubation for respiratory failure because of severe obesity. In addition, with positive urine Legionella antigen he was transferred to our university hospital. On arrival, the patient was conscious, with a height of 178 cm and a weight of 136 kg (BMI 42 kg/m^2, BSA 2.48 m^2), and had a body temperature of 37.6°C, blood pressure of 94/33 mmHg, heart rate of 118 beats/min, respiratory rate of 40 breaths/min with noticeable labored breathing, and an oxygen saturation of 96% (10Liters/min of oxygen). Coarse crackles were heard on auscultation in both lung, particularly the right lower lung field. Laboratory findings on arrival at our hospital showed a white blood cell count of 28,400/μL, CRP of 38.054 mg/dl, and procalcitonin (PCT) of 15.6 ng/ml, indicating a significant inflammatory response. Arterial blood gas analysis showed a PaO_2 of 80.0 mmHg (10Liters/min of oxygen) and a PCO2 of 40.0 mmHg. On the chest X-ray at the time of admission, infiltrative shadows mainly in the right lower lung field were observed (Figure 1), and on chest the CT scan revealed consolidation with air bronchograms was observed from the posterior segment of the right lower lobe to the posterior segment of the middle lobe (Figure 2). The patient's clinical course after admission (Figure 3) involved rapid intubation and mechanical ventilation in the ICU due to respiratory distress and hypoxemia. Legionella pneumonia was diagnosed based on the positive urine Legionella antigen test (BinaxNow, ABBOTT, Chicago, USA) resulted from the previous hospital. Antibiotic therapy with Levofloxacin Hydrate 500 mg/day and Prednisolone Sodium Succinate 100 mg/day was also administered. The settings for mechanical ventilation were PC-A/CV, maximum airway pressure of 30mmHg, PEEP of 12cm H_2O, and FiO_2 of 0.6. Despite mechanical ventilation there was only minimal improvement in oxygenation, therefore, it was necessary to provide intensive respiratory support such as prone positioning in addition to antibiotic therapy for Legionella infection. We recognized the prone positioning was the standard treatment for severe pneumonia, while it carried a high risk of complications due to morbid obesity, and besides Murray score of 3.0 was decisive in the early introduction of V-V ECMO. Under echo guidance in the ICU, a 25Fr drainage cannula was inserted into the right femoral vein and a 23Fr infusion cannula was inserted into the right internal jugular vein. V-V ECMO was initiated with venous drainage from the inferior vena cava and venous infusion into the superior vena cava. The initial settings for V-V ECMO were determined based on the patient's morbid obesity (BMI $\geqq$ 40 kg/m^2, BSA 2.48 m^2), a higher ECMO flow was considered necessary to effectively improve hypoxemia, with an ECMO rotation speed of 4,000 bpm, flow rate of 6.5 Liters/min, sweep gas flow rate of 7.5 Liters/min, and artificial lung FiO_2 of 0.9. Additionally, continuous renal replacement therapy (CRRT) was operated for acute kidney injury under V-V ECMO support. With the assistance of ECMO oxygenation, the administration of antibiotics and steroids, the patient's condition gradually improved, and ECMO was discontinued 12 days after initiation, followed by liberation from mechanical ventilation and 3 days later. Immediately after liberation from mechanical ventilation, the patient temporarily required high-flow nasal cannula (HFNC), but his oxygenation gradually improved, and finally he was transferred to a local hospital for rehabilitation 20 days after admission.

Figure 1. Chest radiograph A/P view on admission showing right side dense infiltrate.

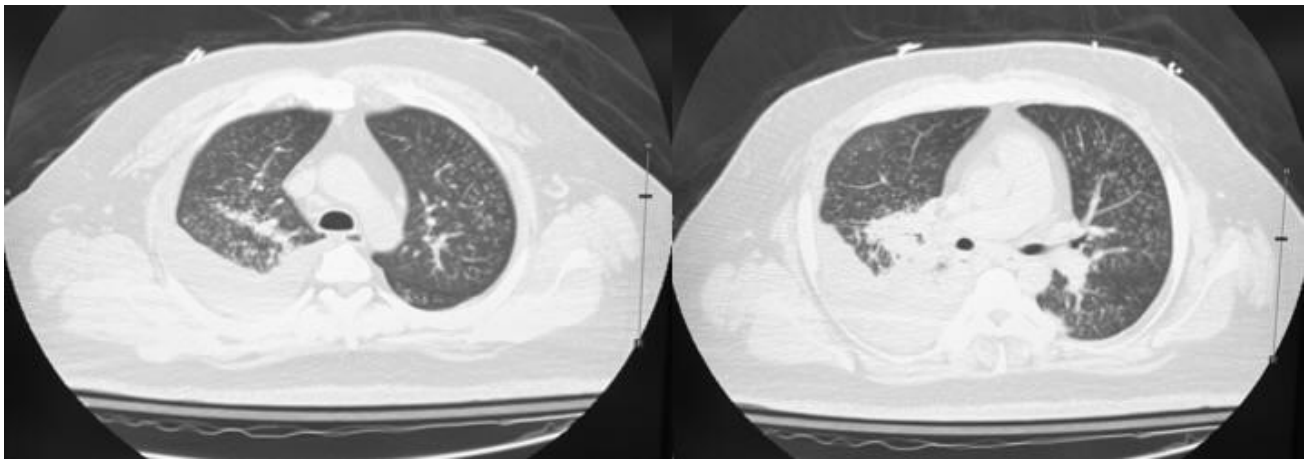

Figure 2. Chest CT on admission showing dense consolidation and mild infiltrate in right.

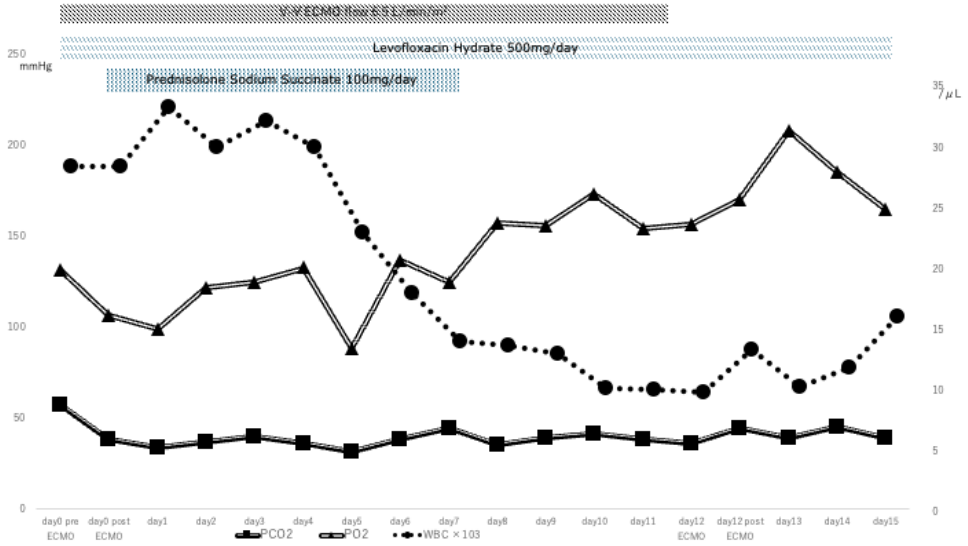

Figure 3. Clinical course of the patient.

3. Discussion

Legionella pneumonia is estimated to account for around 10% of CAP [1] and can also lead to ARDS [2]. In the early 2000s, the reported mortality for patients with severe Legionella infection requiring intensive care was 33% [3]. Therefore, in recent years, ECMO has been actively introduced, and a survival of 84% has been reported, suggesting that ECMO has a positive indication for severe Legionella pneumonia [4]. Furthermore, with the increase in ECMO treatment experience for COVID-19 pneumonia in recent years, epidemiological analysis of Legionella pneumonia in Japan has reported a mortality of 3.4% for ECMO treatment in patients with severe Legionella pneumonia [5]. In patients with morbid obesity, there may be physiological changes in respiratory function. For example, decrease in functional residual capacity and residual volume, expiratory flow limitation and airway resistance in the supine position. Therefore, lung compliance decreases, and there is a tendency for atelectasis in obese patients. Such patients may require additional respiratory management strategies such as higher positive end-expiratory pressure (PEEP) and prone positioning. However, frequent position changes in obese patients require a large number of staff and may increase the risk of complications. Previously, ECMO treatment for patients with morbid obesity (BMI $\geqq$ 40 kg/m^2) was considered relatively contraindicated [6, 7]. However, ELSO(Extracorporeal Life Support Organization) guideline 2021 do not mention obesity as a specific contraindication [8], and there have been reports suggesting that ECMO treatment in patients with morbid obesity achieves similar outcomes to non-obese patients and that obesity alone should not be considered an exclusion criterion for V-V ECMO [9, 10]. However, there are still unresolved issues regarding ECMO treatment in obese patients. The first challenge is vascular access. In patients with morbid obesity, the position of blood vessels can be distorted by adipose tissue, and the blood vessels themselves are often deeper from the skin surface. This often requires a steeper insertion angle during cannulation, leading to multiple trial insertions and the potential for hematoma formation. Some reports recommend the cutdown method of direct cannulation of the artery and vein for morbidly obese patients [10]. However, in this case, the femoral vein was clearly visualized using vascular ultrasound, so percutaneous cannulation under echo guidance was performed for both the right femoral vein and right internal jugular vein, and no significant problems were observed around the cannulation sites even after ECMO initiation. Furthermore, there are also problems in ECMO management. In obese patients, the pressure from adipose tissue and increased intra-abdominal pressure can increase venous drainage resistance, making it difficult to achieve the target flow rate, and additional cannulation may be required [11]. However, in this case, the maximum diameter of the femoral vein measured by vascular ultrasound allowed for the insertion of the largest size drainage cannula, so no additional cannulation was necessary. Although safety is the top priority, in obese patients, it is advisable to choose the largest possible size of the drainage and infusion cannulas. Moreover, patients with severe obesity may have altered pharmacokinetics [12]. In particular, in patients undergoing ECMO insertion, the administration of an appropriate amount of anticoagulant is essential to balance bleeding and thrombosis. In our case, we used continuous infusion of unfractionated heparin for anticoagulation therapy, but the initial weight-based dose of unfractionated heparin intravenous injection caused excessive prolongation of the activated partial thromboplastin time (APTT), and the planned dose based on weight was too high, resulting in clot formation at the entrance of the artificial lung and requiring circuit exchange 12 hours after ECMO initiation. Subsequently, we changed from APTT measurement every 6 hours to every 3 hours, adjusted the actual dose while tolerating what may seem like an excessive dose, and successfully performed anticoagulation therapy during ECMO without bleeding or thrombotic complications, allowing for 12 days of ECMO treatment to be completed.

4. Conclusion

The outcomes of ECMO for severe respiratory failure in patients with Legionella pneumonia have improved, and in the current situation where the survival of ECMO treatment in patients with morbid obesity is reported to be equal to or better than that in non-obese patients. Although various adaptations are necessary, early initiation of ECMO seems to be acceptable for morbidly obese patients who develop severe respiratory failure due to Legionella pneumonia like the case presented here.

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