CASE REPORT

A case of severe cardiogenic shock triggered by Legionella infection treated with veno-arterial extracorporeal membrane oxygenation (VA-ECMO)

Kazuki Momota[1], Shotaro Otani[1], Konomi Moriwaki[1], Natsuki Bando[1], Koji Sato[1], Hiroki Sato[3], Yusuke Akimoto[2], Toshiyuki Nunomura[3], Yoshitoyo Ueno[1], Taiga Itagaki[3], and Jun Oto[2]

[1]Emergency and Critical Care Medicine, Tokushima University Hospital, Tokushima, Japan, [2]Emergency and Critical Care Medicine, Tokushima University Graduate School of Biomedical Sciences, [3]Emergency and Disaster Medicine, Tokushima University Hospital, Tokushima, Japan

Abstract : Background : Pneumonia caused by *Legionella pneumophila* and other *Legionella* spp. is associated with high hospitalization and mortality rates. We herein report a case of severe cardiogenic shock triggered by Legionella pneumonia that was successfully treated with venoarterial extracorporeal membrane oxygenation (VA-ECMO). Case presentation : A 59-year-old man was admitted to the emergency department with a fever and consciousness disturbance. He was diagnosed with Legionella pneumonia based on urinary antigen test results. Despite receiving supplemental oxygen, the patient's oxygenation worsened, necessitating immediate tracheal intubation. Mechanical ventilation and vasopressor therapy were initiated ; however, tachycardia due to atrial fibrillation, along with a reduced ejection fraction of only 15%, led to the development of cardiogenic shock. On day 1 in the intensive care unit (ICU), VA-ECMO and intra-aortic balloon pumping (IABP) were introduced. By day 3, his tachycardia and myocardial dysfunction had improved, leading to the withdrawal of VA-ECMO on day 4. His respiratory function improved and he was extubated on day 7. He was discharged from the ICU on day 9. Conclusions : VA-ECMO is a valuable treatment modality for refractory cardiogenic and septic shock. Considering the induction of VA-ECMO as a therapeutic option at an appropriate time is important in such cases. J. Med. Invest. 72 : 434-437, August, 2025

Keywords **:** *VA-ECMO, L. pneumophila*

INTRODUCTION

Legionnaires' disease is caused by *L. pneumophila* and is the third most common microbial cause of community-acquired pneumonia (3-15%), after *Streptococcus pneumoniae* and *Haemophilus influenzae*. Legionella pneumonia can cause severe acute respiratory distress syndrome. The mortality rate is reported to be 10%, increasing to 27% if appropriate treatment is delayed (1). Lewandowski K reported that venovenous ECMO (VV-ECMO) has been used in cases of severe respiratory failure, including pneumonia, with a survival rate of approximately 55% (2). VA-ECMO is used to treat severe septic shock with cardiovascular dysfunction (3). VV-ECMO has, therefore, been considered the first choice in cases of severe respiratory failure due to *L. pneumophila* ; however, there are very few reports of life-saving results with VA-ECMO (4).

We herein describe a case of severe Legionella pneumonia and cardiogenic shock with arrhythmia that was successfully treated.

CASE PRESENTATION

A 59-year-old man with a history of hyperthyroidism and atrial fibrillation was admitted to the emergency department with a 2-day history of fever and altered consciousness. The patient was taking thiamazole, valsartan, amlodipine, bisoprolol fumarate, and warfarin. On arrival at the emergency department, his vital signs were unstable : Glasgow coma scale, E3V5M6 ; respiratory rate, 40 beats per minute ; blood pressure, unmeasurable ; heart rate, 200 beats per minute (irregular) ; body temperature, 37.8 degrees Celsius ; oxygen saturation, unmeasurable. His blood examination results were as follows : white blood cell count, 10900 /μL ; hemoglobin, 15.1 g/dL ; platelet count, 17.4×10^4 /μL ; C-reactive protein, 41.05 mg/dL ; creatinine kinase, 109338 U/L ; creatinine, 4.48 mg/dL ; brain natriuretic peptide (BNP), 694.7 pg/dL ; total bilirubin, 1.3 mg/dL ; free T4, 1.16 ng/dL ; and thyroid-stimulating hormone (TSH), 0.336 μIU/mL (Table 1). His SOFA score was 13 points. Urinary *L. pneumophila* antigen

Table 1. Blood examination results at admission

WBC	11.2	$\times10^3$μL	CRP	27.1	mg/dL
RBC	3.78	$\times10^4$/ μL	T-Bil	1.3	mg/dL
Hb	12.8	g/dL	AST	1824	U/L
Plt	143	$\times10^4$/ μL	ALT	497	U/L
PT%	68.1	%	LDH	3310	U/L
PT-INR	1.26		CPK	92233	U/L
APTT	33.4	Sec	BUN	45	mg/dL
Fib	808	mg/dL	Cre	4.01	mg/dL
D dimer	10.3	μg/mL	Na	138	mEq/L
FDP	20	μg/mL	K	5.0	mEq/L
			Cl	100	mEq/L
Free T4	1.16	ng/dL	Mg	3.6	mEq/L
TSH	0.336	μIU/mL	BNP	694.7	pg/mL

Received for publication March 5, 2025 ; accepted March 30, 2025.

Address correspondence and reprint requests to Jun Oto, Emergency and Critical Care Medicine, Tokushima University Graduate School of Biomedical Science, Keramoto,3-18-15, Tokushima City, Tokushima, Japan and Fax : +81-88-633-9339. E-mail : joto@tokushima-u.ac.jp

test results were positive. An arterial blood gas analysis revealed the following : pH, 7.149 ; $PaCO_2$, 37.5 mmHg ; PaO_2, 24.4 mmHg (O_2 10 L/min reserver mask) ; HCO_3^-, 11.7 mmol/L ; and lactate, 3.8 mmol/L. Echocardiography revealed a left ventricular ejection fraction (LVEF) of approximately 15 %. The patient was diagnosed with Legionella pneumonia, septic shock, and cardiogenic shock. He was diagnosed with Legionella pneumonia based on a urinary antigen test, and consolidation was observed in the left upper lobe on chest radiography and computed tomography (Figure 2A, 3). Despite receiving supplemental oxygen, the patient's oxygenation worsened, necessitating immediate tracheal intubation. Mechanical ventilation and vasopressor therapy were initiated ; however, tachycardia due to atrial fibrillation, along with a reduced LVEF of only 15%, led to the development of cardiogenic shock. Levofloxacin (LVFX) and meropenem (MEPM) were initiated to treat Legionella pneumonia. For septic shock, the following medications were administered : noradrenaline (0.3 μg/kg/min), vasopressin (1

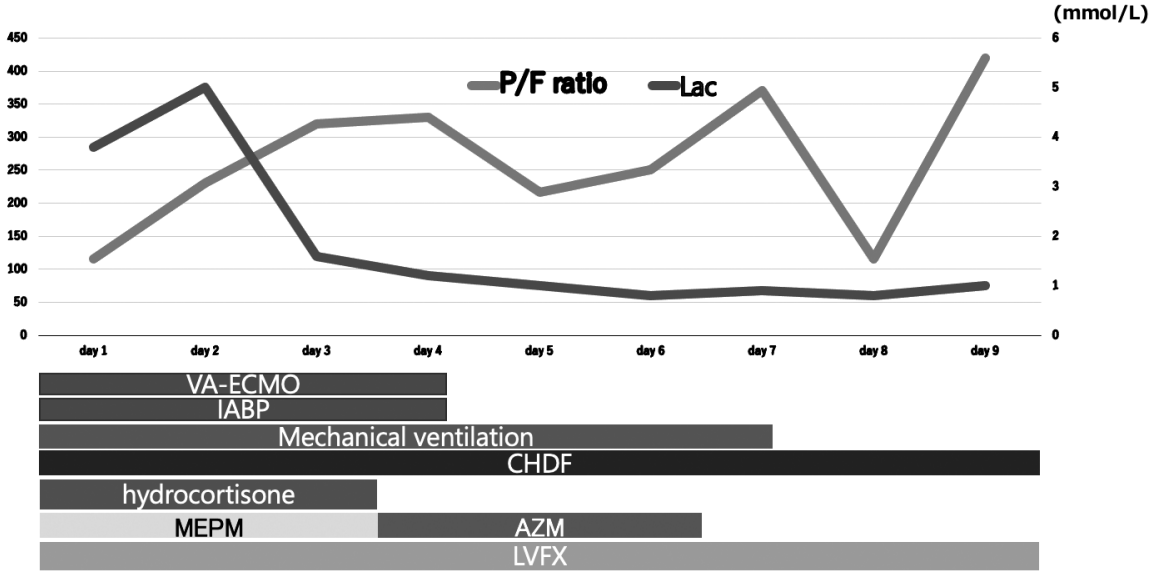

Figure 1. The patient's clinical course in the intensive care unit.
The patient was managed with ECMO until day 4 of admission to the ICU and extubated on day 7. The patient was discharged from the ICU on day 10. Immediately after extubation, a transient decrease in the P/F ratio was observed, which quickly improved.

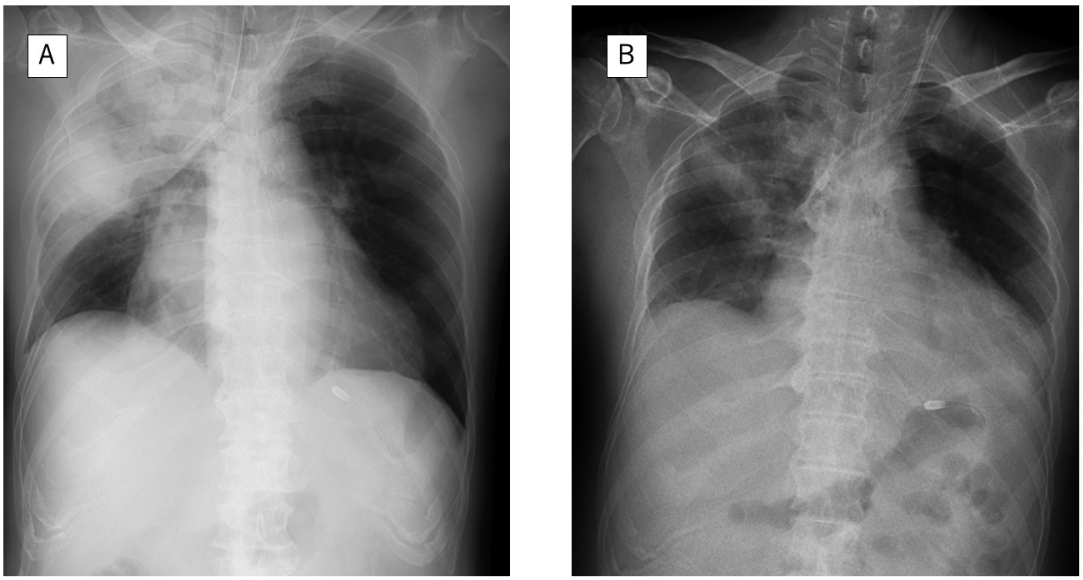

Figure 2. Chest X ray
(A) Initial chest X ray on day 1. An infiltrating shadow is observed in the right upper lung field.
(B) Chest X ray at the time of extubation on day 7.

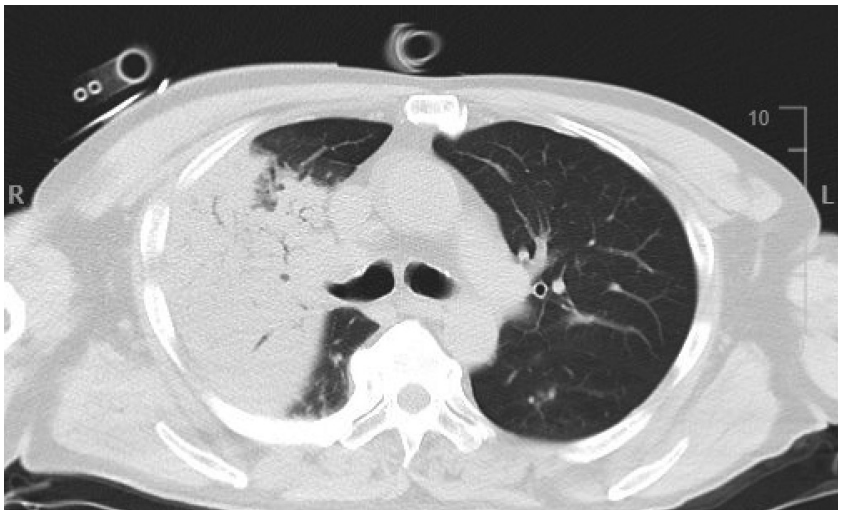

Figure 3. Axial chest computed tomography on emergency department
In this image, an infiltrative shadow with air bronchogram is observed predominantly in the right upper lobe.

U/h), dobutamine (3 μg/kg/min), and hydrocortisone (200 mg/day). To manage atrial fibrillation, landiolol (10 μg/kg/min) was administered, and cardioversion was performed at 100 J and 150 J, however, sinus rhythm could not be restored. Subsequently, metabolic and respiratory acidosis worsened over the next 5 h, VA-ECMO was initiated on ICU day 1, and catecholamines were suspended. Although arterial fibrillation persisted, the patient's heart rate was controlled by suspending catecholamine administration and administering amiodarone at a loading dose. The patient was on cardiac rest with no catecholamine support and reduced afterload. Subsequently, acidemia was ameliorated and his hemodynamic circulation stabilized. He underwent continuous hemodiafiltration (CHDF) for oliguria and acute kidney injury (AKI) due to rhabdomyolysis. On day 3, meropenem was discontinued and azithromycin (AZM) was initiated for severe community-acquired pneumonia. His LVEF improved to 30%. On day 4, the patient's hemodynamics remained stable, with dobutamine (3 μg/kg/min), thus allowing for the discontinuation of VA-ECMO. The patient's lung function gradually improved, and ventilatory weaning was initiated on day 5, leading to extubation on ICU day 7 (Figure 2B). Amiodarone treatment was terminated on day 8 in the ICU. CHDF was switched to hemodialysis due of persistent AKI on day 9. The patient was discharged from the ICU on day 10 without any adverse events. Blood examination results on day 11 were as follows : free T4,1.0 ng/dL ; TSH 6.86 μIU/mL ; and thyroid-stimulating antibody was negative. No additional treatment was provided for the thyroid function. The patient was discharged home on day 26 of hospitalization. After discharge from the hospital, the patient was followed-up by his family physician.

DISCUSSION

In this report, we describe the treatment of a 59-year-old man with Legionella pneumonia using VA-ECMO. He had a history of hyperthyroidism and atrial fibrillation. Atrial fibrillation, referred to as arrhythmia-induced cardiomyopathy, is known to trigger reversible dilated cardiomyopathy (5). Inotropic drugs were administered to treat the septic shock. Dobutamine has been used as a support for cardiac failure to reduce morbidity and mortality in critically ill patients. (6) Morelli *et al*. suggested that β-blockade could be associated with a reduction in the heart rate without any adverse effects, which could help improve survival. (7) Antiarrhythmic drugs often have negative inotropic effects, and electrical reconversion may worsen circulatory failure or even cause cardiac arrest. However, the effectiveness of β-blockers in sepsis remains unclear.

In the present case, hyperthyroidism and atrial fibrillation may have been associated with severe cardiogenic shock. The patient's TSH level was low on admission, despite treatment with thiamazole. The hyperthyroidism may have been poorly controlled. The use of dobutamine for cardiac dysfunction may exacerbate tachycardia, whereas the use of landiolol for heart rate control may not be effective. In atrial tachyarrhythmias, a reduced time for ventricular filling and loss of atrial contribution leads to a significant reduction in cardiac output, thus resulting in cardiogenic shock (8). Managing cardiogenic shock and arrhythmia is challenging. The introduction of VA-ECMO helped to increase the patient's cardiac output, reduce dobutamine levels, and control the heart rate. On day2, all catecholamines and landiolol were discontinued, and the patient's vital signs stabilized. Considering that he was able to be weaned off VA-ECMO within a few days, we considered cardiomyopathy to be a significant factor.

In conclusion, we successfully treated a patient with cardiogenic shock caused by uncontrollable atrial fibrillation using VA-ECMO without any adverse events. In cases of severe infection associated with cardiomyopathy, ECMO should be considered as a life-saving treatment option.

ACKNOWLEDGEMENTS

We would like to thank Brian Quinn, managing editor of Japan Medical Communication (www.japan-mc.co.jp), for editing our manuscript.

No funding was received for this study.

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