Applied use of venovenous extracorporeal membrane oxygenation support in severe septic shock and sepsis induced cardiomyopathy with unknown etiology pneumonia: a case report

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Abstract

BACKGROUD: There is no consensus over the effect of V-V ECMO on septic patients with sepsis-induced cardiomyopathy. CASE PRESENTATION: A 48-year-old male was transferred to our emergency department for acute-onset fever lasting for four days on November 1, 2019. He traveled in many places in northern China (Yan'an, Beijing, Qinhuangdao and so on) one month prior to admission. We initiated V-V ECMO on day 2. The patient's hemodynamics and infection condition improved. After detecting of nasopharyngeal swabs and bronchoalveolar lavage samples, A/H1N1 influenza, influenza B, coronavirus, System Inflammatory Reaction Syndrome (SIRS), Middle East respiratory syndrome (MERS) and other epidemic disease were ruled out. On the day 22, patient's pulmonary images findings revealed the recover. He was transferred to a regular room discharged soon. CONCLUSION: The outcome of our patient shows that V-V ECMO may also benefit the patient when managing septic shock and septic cardiomyopathy.

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Running title: Applied use of V-V ECMO in septic shock and associated septic cardiomyopathy with unknown etiology pneumonia

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ABSTRACT

BACKGROUD: There is no consensus over the effect of V-V ECMO on septic patients with sepsis-induced cardiomyopathy.

CASE PRESENTATION:A 48-year-old male was transferred to our emergency department for acute-onset fever lasting for four days on November 1, 2019. He traveled in many places in northern China (Yan'an, Beijing, Qinhuangdao and so on) one month prior to admission. We initiated V-V ECMO on day 2. The patient's hemodynamics and infection condition improved. After detecting of nasopharyngeal swabs and bronchoalveolar lavage samples, A/H1N1 influenza, influenza B, coronavirus, System Inflammatory Reaction Syndrome (SIRS), Middle East respiratory syndrome (MERS) and other epidemic disease were ruled out. On the day 22, patient's pulmonary images findings revealed the recover. He was transferred to a regular room discharged soon.

CONCLUSION: The outcome of our patient shows that V-V ECMO may also benefit the patient when managing septic shock and septic cardiomyopathy.

KEY WORDS: Extracorporeal membrane oxygenation, sepsis, shock, unknown etiology pneumonia

INTRODUCTION

Caused by a dysregulated host response to infection, severe septic shock could lead to sepsis-induced cardiomyopathy (SIC) and even acute respiratory distress syndrome (ARDS), resulting in life-threatening organ dysfunction eventually[1,2]. Despite of the advanced supportive and antibiotic treatments, sepsis is associated with a high fatality risk nowadays. The short-term death from severe sepsis is up to 40%[3]. Either community-acquired or health care–associated infections, such as pneumonia, intraabdominal and urinary tract infections could contribute to the occurrence of sepsis.

The reports of extracorporeal membrane oxygenation (ECMO) application in critical patients have been increased currently. Veno-venous extracorporeal membrane oxygenation (V-V ECMO) is mostly used for patients with refractory respiratory failure[3]. Veno-arterial extracorporeal membrane oxygenation (V-A ECMO) is indicated for decompensated chronic heart failure patients. Some studies have reported that it is successful for patients with SIC under the treatment of V-A ECMO [1,4]. While, there is no consensus over the effect of V-V ECMO on septic patients with SIC.

In this study, we first report the successful application of V-V ECMO on a 48-year-old male patient of septic shock and SIC with no specific etiological pneumonia.

CASE PRESENTATION

A 48-year-old male was transferred to our emergency department for acute-onset fever lasting for four days on November 1, 2019. The highest temperature was 40. He traveled in many places in northern China (Yan'an, Beijing, Qinhuangdao and so on) one month prior to admission. Treated in the local clinic 2 days ago, the symptoms of the patient were getting worse with generalized cold limbs, exacerbated dyspnea and developed anuria. The blood pressure was as low as 55/40mmHg, heart rate was 55 bpm, oxygen saturation was 74%, and the skin mottling score (SMS) was 5 (**Figure 1A, 1B**). His initial vital signs in our hospital were as follows: respiratory rate: 22 breaths/min; heart rate: 136 beats/min; blood pressure: 136/100 mmHg; the temperature is too low to measure; and oxygen saturation, 100% on non-invasive ventilation treatment. Auscultation of the lungs revealed wheezes and crackles. Blood gas analysis showed hypoxia and metabolic acidosis with hyperlactatemia. Laboratory studies showed WBC: 8.97*10ˆ9/L, N 84.1%, HB: 200 g/L, PLT 55*10ˆ9/L, PCT 3.86ng/ml, CRP 94.40mg/L, APTT 104.0sec, LDH 4351U/L, high-sensitivity troponin 36.14pg/mL, myoglobin 391ng/mL, BNP 209pg/mL. The results of echocardiography were unremarkable. The CT scan of the pulmonary before admission showed bilateral pulmonary infection with pulmonary edema and bilateral pleural effusion**(Figure 2A)** . Then, the patient was admitted to the ICU under the consideration of severe sepsis, septic shock, moderate ARDS, bilateral pneumonia, pulmonary edema, and acute kidney injury.

After admission, antibiotics (oseltamivir, Imipenem-Cilastin Sodium, linezolid, moxifloxacin, and

azithromycin), hydrocortisone, vasopressors (norepinephrine), and immunotherapy were initiated. Continuous renal replacement therapy (CRRT) and mechanical ventilation therapy were also initiated. The changes of body fluid and adjustment of antibiotics shows in **Figure 3.**

Before introducing ECMO, the mechanical ventilator was set to the airway pressure-controlled mode (positive end-expiratory pressure, 12 cm H_2O; fraction of inspired oxygen, 0.6). The pre-ECMO implantation Sequential Organ Failure Assessment (SOFA) score was 12 points, and Acute Physiology and Chronic Health Evaluation II (APACHE II) score was 30 points. In ICU, the PaO_2 /FiO_2 of the patient gradually deteriorated, V-V ECMO and prone position ventilation were implemented on the second day (**Figure 1B**). On the same day after the application of V-V ECMO, the echocardiography revealed that the ejection fraction (EF) of the patient strikingly dropped to 25%. Once V-V ECMO was initiated, the patient gradually recovered from the infection and circulatory failure and accordingly cardiac index and oxygenation were improved. The skin mottling subsidized on the day 3. On the day 5, the echocardiography indicated the EF of 55%. He was successfully weaned from V-V ECMO on day 6 and mechanical ventilation on day 11. And on the day 15, the EF of the patient was 62%. Therefore, the patient was diagnosed as sepsis induced cardiomyopathy.

After detecting of nasopharyngeal swabs and bronchoalveolar lavage samples, A/H1N1 influenza, influenza B, coronavirus, System Inflammatory Reaction Syndrome (SIRS), Middle East respiratory syndrome (MERS) and other epidemic disease were ruled out. And after the admission to the ICU, the patient had a long-term fever (**Figure 3)** . On the day 22, patient's pulmonary images findings revealed the recover (**Figure 2B**). He was transferred to a regular room discharged soon.

DISCUSSION

The clinical manifestations of sepsis are highly variable, depending on the initial site of infection, the causative organism, the pattern of acute organ dysfunction, the underlying health status of the patient, and the interval before initiation of treatment[5]. The patient had met the diagnostic criteria of sepsis when admission. He received the examinations of pathogeny of local Centers for Disease Control and our hospital at the time of hospitalization but no tests results were positive. In this case, we mainly provided supportive treatment and antibacterial treatment.

In 1984, Parker et al. first proposed the concept of sepsis induced cardiomyopathy[6]. Recent literature suggests that >10% of patients with sepsis and septic shock develop septic cardiomyopathy. They observed that 65% of patients with septic shock developed left ventricular systolic dysfunction (defined as ejection fraction $<$ 45%). SIC is a reversible myocardial dysfunction caused by sepsis, and can be reversed in 7–10 days. The SIC has been summarized as a global (systolic and diastolic) but reversible dysfunction of both the left and right sides of the heart. More than half of sepsis patients have secondary sepsis cardiomyopathy. The combination of dysregulation of inflammatory mediators, mitochondrial dysfunction, oxidative stress, disorder of calcium regulation, autonomic nervous system dysregulation, and endothelial dysfunction contribute to the complex pathogenesis of SIC[7-10]. In addition to the use of vasoactive drugs, mechanical support with Intra-aortic balloon pumping (IABP) or ECMO seems to be the last option for unresponsive severe cardiogenic shock due to SIC. IABP is used to increase the cardiac output and reduce the dosage of a vasopressor. Consequently, IABP prolongs survival time and lowers vasopressor requirements[11]. ECMO is a life-saving method which is used extensively due to its significant role in providing support in patients with respiratory failure, cardiac failure, or both. It helps via a modified form of cardiopulmonary bypass providing time to rest the patients' lung[12,13]. There are some studies reported the successful use of V-A ECMO in patients with SIC[1,4]. In our study, the patient used the V-V ECMO treatment due to ARDS. He progressed to SIC during the application of ECMO. Compared with V-A ECMO, patients undergoing V-V ECMO get more stable hemodynamic, and less complications as well. Therefore, the case showed that patient with sepsis and sepsis induced cardiomyopathy could benefit from V-V ECMO.

The patient had fever before admission, but the fever persists even after antibiotics are used. However, the PCT tended to return to normal, indicating that the anti-infection treatment was effective. The eosinophils count substantially increased at the time of hospitalization. And the patient recovered from the fever as

soon as moxifloxacin was stopped **(Figure 3)** . Therefore, the fever was more likely to be caused by drugs. There are many reasons may contribute to the drug-induced fever, and the allergic reaction is the most common one[14]. Therefore, elevated serum total IgE and eosinophil counts are common manifestations of drug fever[14,15]. For patients with persistent high body temperature, we should accurately assess the patient's condition, timely determine the cause of fever, and provide the most reasonable drug regimen for patients.

In conclusion, we report a patient with severe septic shock and sepsis induced cardiomyopathy who recovered from V-V ECMO and prone position ventilation treatments. The outcome of our patient shows that V-V ECMO may also benefit the patient with less complications when managing septic shock and septic cardiomyopathy.

CONFLICT OF INTERESTS

None declared.

AUTHOR CONTRIBUTIONS

FL, LY and JC collected the patient information. FL drafted the manuscript. All authors approved the final version of the manuscript and can be held accountable for the integrity of the work.

ETHICS STATEMENT

The study was approved by the Institutional Review Board (IRB) of the first affiliated hospital of Soochow university. The authors confirm that written consent for submission and publication of this case report including images and associated text has been obtained from the patient in line with COPE guidance.

Figure legend

Figure1 S kin mottling of the patient when admission to the hospital (A); The patient was ventilating in the prone position during V-V ECMO (B).

Figure2 Dynamic changes of pulmonary images findings. Patient's pulmonary images findings before admission to the hospital (A). Patient's pulmonary images findings on the discharge day of ICU (B).

Figure3 Clinical course during intensive care unit stay. Dynamic highest daily temperature, PCT, eosinophils count, body fluid changes and the adjustment of antibiotics during the hospitalization.

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Figure 1. Skin mottling of the patient when admission to the hospital (A);The patient was ventilating in the prone position during V-V ECMO (B).

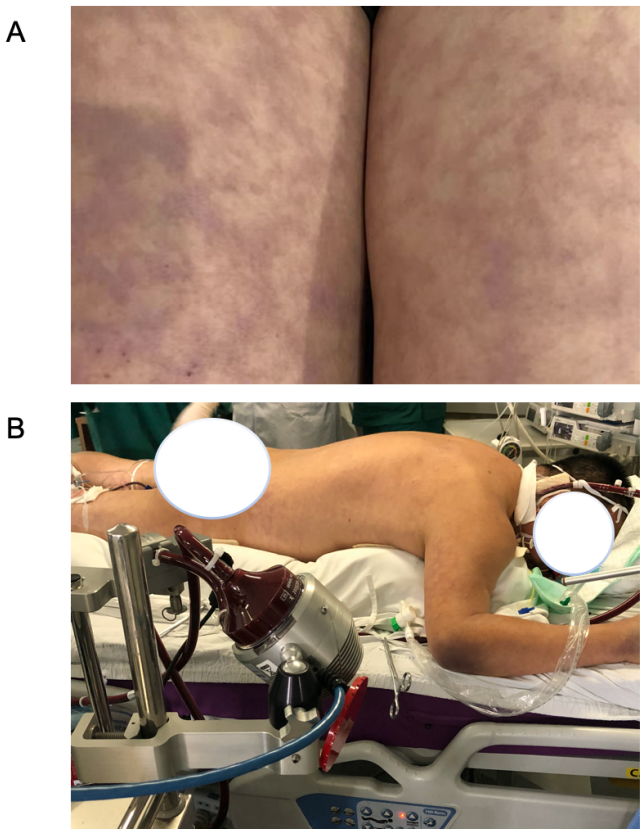

Figure 2. Dynamic changes of pulmonary images findings. Patient's pulmonary images findings on admission to the hospital (A). Patient's pulmonary images findings on the discharges day of ICU(B). DAY-1

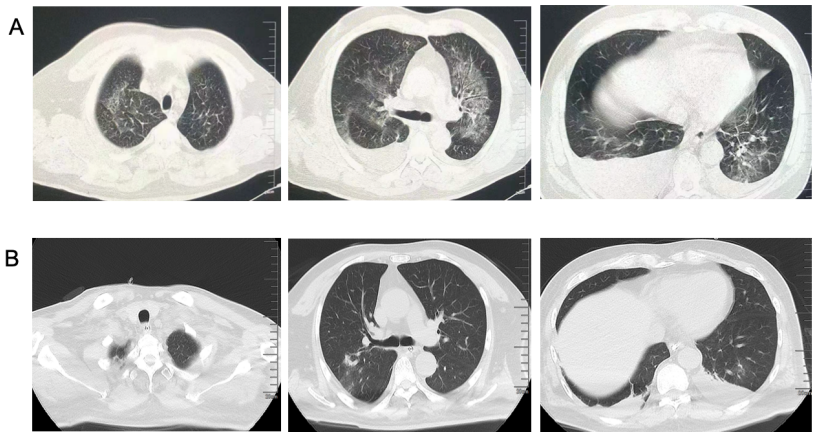

Figure 3. Clinical course during intensive care unit stay. Dynamic highest daily temperature, PCT, eosinophils count, body fluid changes and the adjustment of antibiotics during the hospitalization.