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Severe Legionella pneumophila pneumonia treated with extracorporeal membrane oxygenation (ECMO): A case report

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ABSTRACT

Legionella pneumophila is an aerobic, Gram-negative bacterium, whose natural environment are aquatic reservoirs. The source of infection may be also tap water, fountains and air-conditioners. Among young people, it can cause only mild infections, however a lot of patients must be admitted to the hospital, of which 10% require a stay in the intensive care unit. *Legionella pneumophila* infection can manifest as severe, multi-lobe and bilateral pneumonia, which can lead to acute respiratory distress syndrome (ARDS).

We describe the case of a 26-year-old male patient with *Legionella pneumophila* pneumonia treated with the use of extracorporeal membrane oxygenation (ECMO).

***Keywords*:** Legionella pneumophila, pneumonia, acute respiratory distress syndrome, extracorporeal membrane oxygenation

INTRODUCTION

Legionella pneumophila is an aerobic, intracellular, Gram-negative bacterium, whose natural environment are aquatic reservoirs such as ponds, lakes, rivers and swamps. The source of infection may be also tap water, fountains and air-conditioners. The optimum growth temperature for this pathogen is 20-40^{o}C. People become infected by inhalation of contaminated aerosols. After entering the lungs and then into the alveoli, they are phagocytized by macrophages to which they have a high affinity. The ability to survive intracellularly is conditioned by the ability to inhibit the fusion of phagosomes with lysosomes, disrupt bactericidal transport, and impair vacuole acidification. The destruction of infected cells occurs as a result of intensive replication of the pathogens. *Legionella pneumophila* strains are spread via the blood and lymphatic pathways, as well as by continuity [1, 2].

Infection with *Legionella pneumophila* can cause two different syndromes: Legionnaires' disease and Pontaic fever. Legionnaires' disease was described for the first time in 1977 [3]. It can manifest as pneumonia of different severity and is responsible for 3-18% of community-acquired pneumonia [4]. Among young people it can cause only mild infections, however a lot of patients must be admitted to the hospital, of which 10% require a stay in the intensive care unit (ICU). The incubation period may be up to two weeks. It usually occurs in the form of severe, multi-lobe and bilateral pneumonia, which can lead to acute respiratory distress syndrome (ARDS). The disease starts suddenly, with headaches and muscle aches, lack of appetite, general weakness and worse mood. High fever, dry cough, purulent discharge, gastrointestinal and nervous system symptoms can also occur in some cases [5]. However, it should be noticed that the most characteristic symptoms of *Legionella pneumophila* pneumonia are: sudden onset with very high fever, speckled chest X-ray infiltrates and no response to treatment with β-lactam antibiotics [1, 6]. To confirm Legionnaires' disease, one of the following conditions must be fulfilled:

- isolation of Legionella pneumophila from the culture of samples of material obtained from the patient;
- detection of Legionella bacterial antigen in the patient’s urine;
- finding seroconversion in two serum samples obtained one week apart [7].

Despite the progress made in medicine and current diagnostic and therapeutic options, Legionella pneumophila can cause severe, life-threatening respiratory failure even in a young and healthy patient. The methods used in therapy require a specialized center and large

financial outlays. Extracorporeal membrane oxygenation (ECMO) therapy does not cure, it only gives time to conduct effective therapy, what in the case of infection is antibiotic therapy. Because ECMO is a very invasive therapy with many complications [8, 9], it is important to decide on ECMO support only in cases, where the criteria were fulfilled and the disease is reversible.

In this paper, we describe the case of a 26-year-old patient with Legionella pneumophila pneumonia treated with the use of ECMO.

CASE REPORT

A 26-year-old professional driver without previous medical history was admitted to the ICU due to acute respiratory failure in course of community-acquired pneumonia. The patient reported to the general practitioner because of respiratory tract infection, fever (40°C), weakness with shortness of breath and tachycardia. He reported that he had returned from a business trip from Italy in the heat and with broken air conditioner in the car. After 3 days of outpatient treatment, he was admitted to the ICU of district hospital due to deterioration of respiratory capacity. On admission, C-reactive protein (CRP) concentration was 248 mg/l and chest X-ray revealed inflammatory changes in both lungs with predominance on the right side (Figure 1). In microbiological tests: respiratory culture negative.

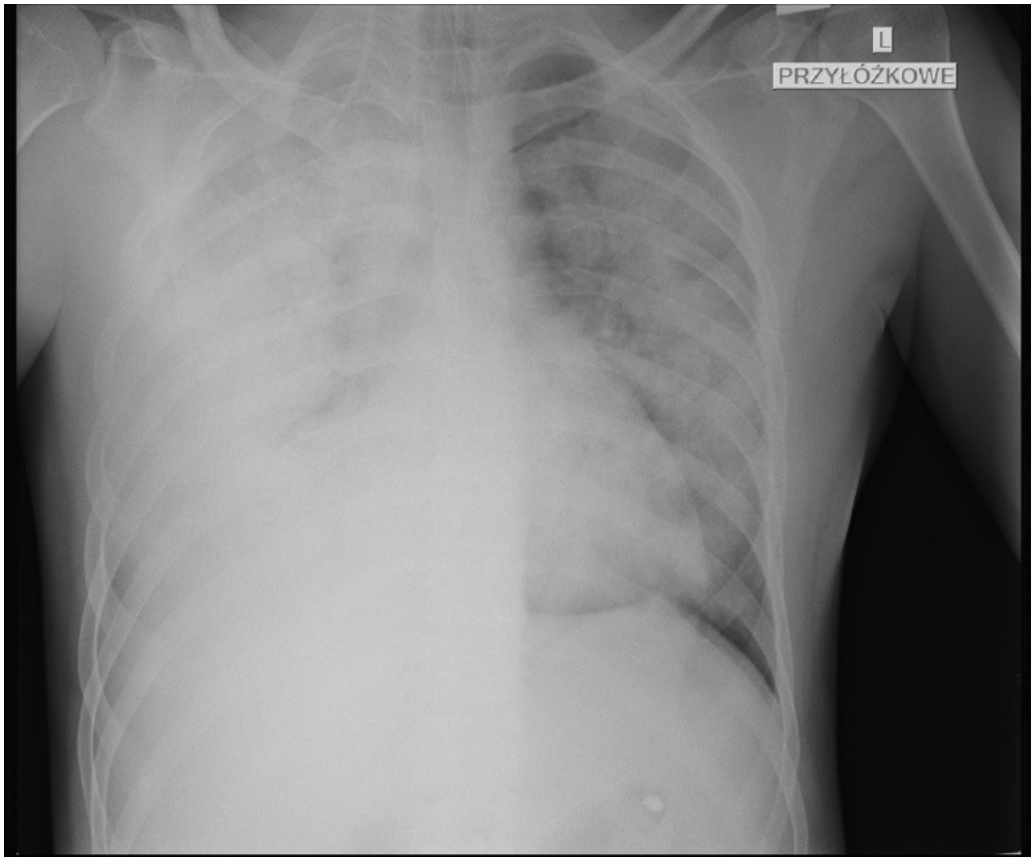

Figure 1. Chest X-ray revealing extensive infiltrates in the pulmonary tissue [authors' material]

Despite the implementation of conventional treatment and targeted antibiotic therapy, the patient's general condition deteriorated systematically, asphyxia increased with respiratory acidosis and CO_2 retention. At the time of admission to a center with a higher degree of reference, mechanical ventilation with 100% FiO_2 and multimodal sedation were administered (PEEP 12, PaO_2 50 mm Hg, pH 7.2 and $PaCO_2$ 70 mm Hg). Intensive therapy was implemented, including broad-spectrum antibiotic therapy (levofloxacin, ceftriaxone, metronidazole) as well as leveling acid-base and water-electrolyte balance. In microbiological tests: respiratory culture was still negative, but L*egionella pneumophila* antigen in urine was positive

Due to the lack of improvement in gas exchange – on the third day of stay, it was decided to implement veno-venous extracorporeal membrane oxygenation (VV ECMO).

During therapy, the most common complications occurred bleeding and infections. Despite the administered treatment, gas exchange in the lungs did not allow reduction of aggressive ventilation on the respirator, and the patient required multimodal sedation and relaxation, broad-spectrum antibiotic therapy, and intestinal feeding. In the following days, ARDS

lesions covered the entire lung fields (Figure 2). On the 15th day of stay, the inflamed lung was damaged – pneumothorax with hematoma developed.

Figure 2. Computed tomography (CT) scan showed the airless areas covering most of the lung fields and bronchogram – bronchial patency was maintained [authors' material]

As an urgent procedure, a drain to the right pleural cavity was inserted, burdening pneumothorax and partly hematoma. The next day, 1300 ml of blood was drained. In the following days, bleeding from the right pleural cavity was observed and a scouting thoracotomy was performed with the formation of a window with partial removal of the VI rib. Further hospitalization resulted in an improvement in gas exchange in the lungs enabling reduction of FiO_2 and an increase in tidal volume and minute ventilation enabling a reduction in the support of mechanical ventilation. On the 35th day of therapy, it was decided to stop ECMO therapy. Since then, the patient was mechanically ventilated with the possibility of reducing the support of the respirator to complete disconnection from the ventilator. After a month, the patient was able to breath on his own, with satisfactory gas exchange. The control chest CT showed regression of the changes. At the time of transfer, the patient was conscious in logical contact, cooperating efficiently.

DISCUSSION

The case of simple infection, that we described, has resulted in severe, life-threatening pneumonia with the need for ECMO support in a young patient without previous medical history.

The main risk factors for Legionnaires' disease are age over 50 years, male gender, smoking, alcoholism, diabetes, taking immunosuppressant drugs, as well as impaired immunity [10].

Infection with *Legionella pneumophila* can cause ARDS. These bacteria caused complex damage of the alveolar-capillary barrier, what increased its permeability and led to direct damage to the pulmonary parenchyma. The clinical condition of described patient was a manifestation of alveolar degradation and floods with protein-rich material and cellular debris with a subsequent increase in pulmonary vascular resistance. As a consequence, the alveoli became less susceptible, the lungs became "stiff" and atelectasis occurred. Some of the alveoli were not ventilated or were poorly perfused despite proper ventilation [11]. This resulted in the development of ARDS and the need for hospitalization at the ICU.

The patient's condition and blood gas results indicated to start ECMO support. The Extracorporeal Life Support Organization (ELSO) indicates in its guidelines that ECMO therapy should be implemented when the patient has an 80% probability of mortality, when $PaO_2/FiO_2 < 100$ on $FiO_2 > 90\%$ [12]. In this case, the criteria were fulfilled.

The analysis of available publications found only 7 case reports describing *Legionella* infection requiring ECMO therapy. A similar case and the same treatment were described by Thiara et al. in 2009 [13]. As in our case, previously healthy male required ECMO therapy for *Legionella* pneumonia. The only complications that have occurred were thoracic bleeding. The main difference is that he was successfully supported on VV ECMO for 59 days with the same oxygenator. Whereas our ECMO therapy lasted for 35 days.

Except for case described by Thiara et al. [13], other cases of *Legionella pneumophila* infection refer to heavily burdened patients. Oda et al. described the case of a 62-year-old man who was a heavy smoker with diabetes mellitus and developed ARDS after *Legionella pneumophila* infection at work, in which he was removing rubble and soil [14]. Francisco Giuseppe De Rosa in his article describes the case of a HIV-infected patient who, despite highly active antiretroviral therapy, developed ARDS and required ECMO support. In addition, he had complications in the form of liver failure [15]. The patient described by

Laivier et al. was also an alcoholic smoker and additionally suffered from sleep apnea requiring CPAP support during the night. The course of his illness was more dramatic, because he developed extreme rhabdomyolysis, acute renal failure and protracted ileus [16]. Our patient did not experience complications directly related to Legionnaires' disease. However, the need for ECMO therapy resulted in blood coagulation disorders and hematomas.

It should be emphasized that not only risk factors, but also the source of the infection is important in *Legionella pneumophila* infection. Wüthrich et al. proved, that the air-conditioner cooling towers (ACCT) were the source of *Legionella* infections during outbreake in Basel in 2017 [17]. In our case, the patient took a long car journey during the hot summer before becoming ill. Therefore, the air conditioning of his car is the most likely source of infection. It should be considered when diagnosing severe community-acquired pneumonia.

CONCLUSIONS

Legionella pneumophila must be considered as a possible cause of community-acquired severe pneumonia in cases, when standard therapy is ineffective. For outpatients, advice concerning the cleaning of air conditioning in office rooms and cars must be emphasized. In some cases, extracorporeal membrane oxygenation may be necessary.

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