

Pneumonia Caused by Community-Acquired Methicillin-Resistant *Staphylococcus aureus*: Vancomycin or Linezolid?

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To the Editor: During the past decade, community-acquired, methicillin-resistant *Staphylococcus aureus* (CA-MRSA) cases, which show rapid progression and high mortality, have emerged worldwide. However, invasive CA-MRSA infections are relatively rare in our clinical work, some CA-MRSA pneumonia cases were reported during the past years. Here, we describe a case of CA-MRSA pneumonia that was successfully treated using a combination of antimicrobials and surgical therapy.

A previously healthy 14-year-old male was transferred to China-Japan Friendship Hospital by ventilator on April 05, 2015, for fever, stuffy nose, and progressing dyspnea. The first chest computed tomography (CT) scan revealed bilateral nodular opacities [Figure 1a]. MRSA was cultured both from sputum and blood cultures at the local hospital. Despite a 12-day course of vancomycin and imipenem, the disease rapidly worsened, and the patient produced purulent blood-tinged sputum with new-onset bilateral pyopneumothorax [Figure 1b] and was treated with closed thoracic drainage before being transferred.

Laboratory examinations after admission showed leukocytosis ($10.1 \times 10^9/L$ with 82% neutrophils and 10% lymphocytes), a high procalcitonin (PCT) level (1.08 ng/ml, reference value <0.5 ng/ml), a low CD4 lymphocyte level ($521/\mu l$), either atypical pathogen antibodies or common virus antibodies that yielded negative results, and negative screening for tuberculosis. The chest CT was re-examined [Figure 1c] after admission. Bronchoscopy revealed purulent sputum in most bronchi [Figure 1d], and the bronchoalveolar lavage fluid (BALF) was bloody and thickened [Figure 2]. MRSA was cultured from both BALF and pleural drainage cultures, and typing revealed that the MRSA belonged to ST59, carried SCCmec type IVa, and was positive for Pantone-Valentine leukocidin (PVL) (Micro Scan: MALDI-TOF MS, Bruker Daltonics, Germany; Drug resistance: bioMérieux VITEK compact-2, GP67, France).

The patient continued to receive vancomycin along with cefoperazone-sulbactam because the minimum inhibitory

concentration of MRSA for vancomycin is below 0.5 mg/L. The dose was adjusted to 1.0 g three times per day until the trough level concentration of vancomycin was 14 mg/L. Since the creatinine clearance rate (Ccr) showed a high value of 204 ml/min, we found that the vancomycin level was 747.5 mg in the urine after vancomycin administration for 7 h, and the next day, the trough level concentration was reduced to 5 mg/L. We therefore switched to linezolid (600 mg Q12 h) on April 10, 2015. Moreover, the patient completed another two cycles of closed drainage on both sides of the chest due to left pneumothorax and right empyema, and a daily urokinase dose of 100,000 U was injected to accelerate the elimination of pus. To reduce the incidence of ventilator-associated pneumonia, we performed a percutaneous tracheostomy on April 08, 2015, and the temperature, leukocytes, and PCT then gradually decreased to normal levels. On April 21, 2015, the upper left and upper right tubes were removed. On April 29, 2015, we expurged the left chest empyema using a thoracoscope. Weaning from mechanical ventilation was started on May 5, 2015. On May 11, 2015, another chest CT showed that most of the pulmonary lesions had been absorbed and that the bilateral pneumothorax had faded [Figure 3]. Afterward, both sides of the lower right tubes were removed. On May 15, 2015, the tracheostomy tube was pulled out, and the patient was discharged.

In recent years, many reports of CA-MRSA have revealed that young people with influenza easily acquire CA-MRSA, which is highly virulent, always carries PVL, and can result in severe clinical symptoms and a high mortality rate.^[1,2] Although the major risk factors for CA-MRSA remain unidentified, research studies have shown that influenza; gregariousness between

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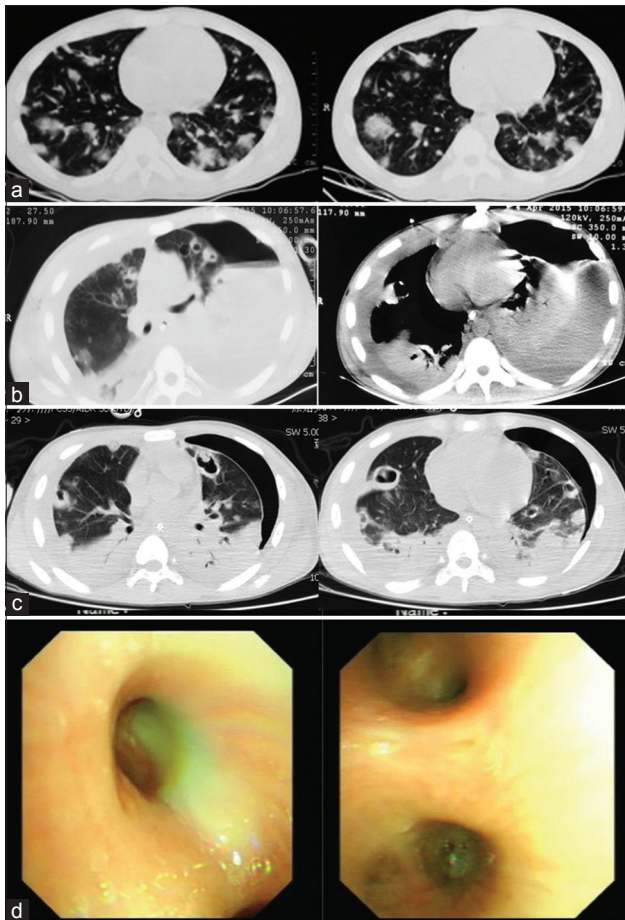


Figure 1: (a) A computed tomography scan of the chest performed on March 25, 2015, notably displayed bilateral nodular opacities. (b) A computed tomography scan of the chest performed on April 4, 2015, notably revealed opacity and new-onset bilateral pyopneumothorax. (c) A computed tomography scan of the chest performed on April 6, 2015, notably revealed multicavity pneumonia, bilateral emphysema, and left pneumothorax. (d) Bronchoscopy revealed that a purulent secretion blocked the apicoposterior segment of the upper right lobe (left) and the main left bronchus (right).

prisoners or soldiers; close body contact, such as between athletes; and intravenous drug use are strong risk factors.^[3] The US Centers for Disease Control and Prevention Active Bacterial Core Surveillance Programme defines CA-MRSA cases as patients with MRSA infection and no history of the following: surgery, hospitalization, or residence in a long-term care facility within the year before infection; the presence of a percutaneous device or indwelling catheter; dialysis within the previous year; hospitalization more than 48 h before MRSA culture; or a previous MRSA infection or colonization.^[3,4] The current patient was a previously healthy teenager who initially reported flu-like symptoms and then developed a high fever and shortness of breath. His lung CT images showed necrotizing pneumonia, and his sputum and blood cultures both yielded strains of MRSA. We combined clinical features, epidemiology, genotyping, and SCCmec typing to define the patient as having CA-MRSA pneumonia.

Appropriate antibiotic selection is important for decreasing the high fatality rate after diagnosis. The Infectious Diseases Society of America recommends vancomycin and linezolid

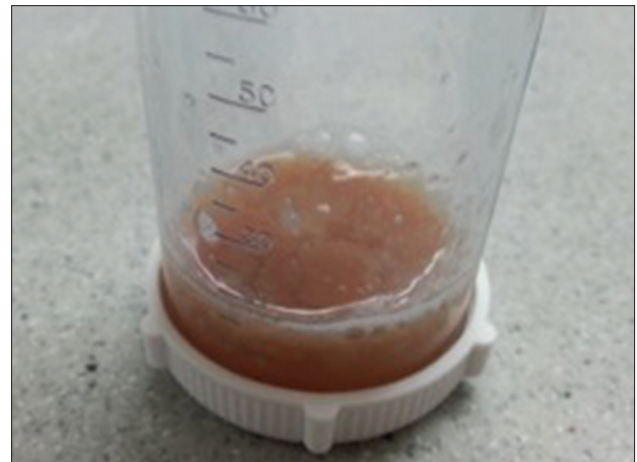


Figure 2: The bronchoalveolar lavage fluid contained bloody and thickened fluid.

as first-line drugs for the treatment of CA-MRSA infection.^[5] In our case, vancomycin (1.0 g Q12 h) was initially used to treat the patient (weight, 60 kg) for 12 days. However, its trough concentration reached only 1.96 mg/L. After adjusting the dosage (1.0 Q8 h), the trough concentration increased to only 5–14 mg/L. We explored the reason for this finding and determined that the high CCr of the patient and the large urinary drug dose (747.5 mg after 7 h) might have resulted in an insufficient blood concentration of vancomycin. Studies have shown that up to 61% of critical patients do not reach the target trough concentration (≥ 15 mg/L) when administered conventional therapy that includes vancomycin,^[5] which might be due to the fact that many patients with severe symptoms display augmented renal clearance (ARC) and high ARC has been correlated with a markedly insufficient vancomycin dosage.^[6,7] Moreover, the concentration of vancomycin in lung tissues is far below that in blood, and this finding might be responsible for its poor efficacy. Linezolid (thiazolidinedione) can overcome these difficulties because of its low molecular weight, improved lung tissue penetration, and high tissue concentration in lung tissues and has the same antibacterial effects as vancomycin.^[8] In this study, after switching to linezolid, the patient's body temperature decreased to a normal level, and the clinical symptoms improved. To avoid recurrence, the standard time frame for drug withdrawal is 3 weeks after negative results from blood cultures, respiratory secretions, and pleural effusion cultures are obtained.

In addition, drainage is a vital therapeutic tool for improving CA-MRSA pneumonia.^[9] We adopted the use of a thick caliber chest tube to process closed drainage from the thoracic cavity and urokinase injection into the pleural cavity to assist in effusion drainage and empyema clearance. Moreover, we expurged the left chest empyema using a thoracoscope and performed pleural decortication to improve the patient's respiratory function.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the journal. The patient understands that his name and initial will not be published and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

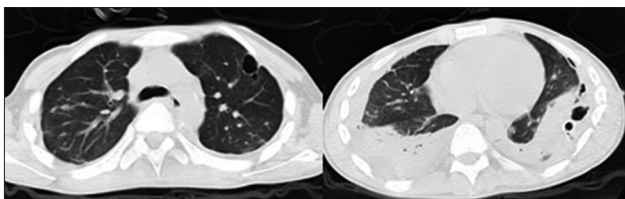


Figure 3: A computed tomography scan of the chest performed on May 11, 2015, showed that the pulmonary lesion was mostly absorbed and the bilateral pneumothorax had faded, but the bilateral emphysema remained.

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Conflicts of interest

There are no conflicts of interest.

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