**Citrobacter koseri Pneumonia As Initial Presentation of Underlying Pulmonary Adenocarcinoma**

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**ABSTRACT:** *Citrobacter koseri* is a motile, gram-negative rod traditionally known to cause infection in individuals with significant comorbidities and immunocompromised status. While most cases represent nosocomial infections, rarely community-acquired infections have been reported. We present a previously healthy man in his 60s with *C. koseri* pneumonia who was subsequently found to have underlying pulmonary adenocarcinoma, illustrating the need for further investigation for immunodeficiency and/or intrapulmonary pathology.

**KEYWORDS:** pneumonia, pulmonary adenocarcinoma

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**Introduction**

*Citrobacter koseri*, formerly known as *Citrobacter diversus*, is a facultative anaerobe and motile, gram-negative bacillus of the family Enterobacteriaceae. *Citrobacter* spp. have been implicated in a wide array of disease processes, including urinary tract infections, pneumonia, and bacteremia. Most commonly infecting individuals with severe comorbidities or immunocompromised status, *C. koseri* has only rarely been described as causing infections in immunocompetent healthy adults. We report a previously healthy patient presenting with *C. koseri* pneumonia with a subsequent diagnosis of pulmonary adenocarcinoma.

**Case Report**

An immunocompetent man in his 60s with a past medical history significant for a remote provoked pulmonary embolism and nicotine dependence was admitted for bilateral non-massive pulmonary emboli in the setting of a right upper lobe infiltrate. Several weeks prior to admission, he developed progressive exertional dyspnea with a non-productive cough, fever, and myalgia. He was diagnosed with right upper lobe community-acquired pneumonia (based on chest X-ray) and treated for seven days with azithromycin. Despite antibiotic therapy, he developed productive cough associated with blood-tinged sputum and worsening dyspnea, causing him to be sedentary. The week prior to admission, he also noted progressive swelling of his left lower extremity prompting his return to care. An ultrasound of his left lower extremity revealed a deep venous thrombosis, and chest CT angiogram revealed multiple pulmonary emboli with a dense consolidative infiltrate in the right upper lobe with smaller patchy infiltrates in the left upper lobe and bilateral lung bases (Fig. 2).

He denied any prior weight loss, muscle weakness, joint swelling, or rashes. His initial vital signs revealed a low-grade temperature of 38.0 °C, blood pressure of 132/77 mmHg, and mild hypoxia with oxygen saturation in the low 90 s on room air. Physical examination was notable for a significant asymmetric swelling of the left lower extremity. Pulmonary auscultation revealed scattered rhonchi and a few expiratory wheezing bilaterally. No clubbing was observed. The remainder of the physical examination was unremarkable.

Laboratory evaluation was significant for leukocytosis of 13.1 x 10³/mm³ with an elevated fraction of neutrophils and an elevated C-reactive protein of 61.8 mg/L (normal ≤8.0 mg/L). Owing to failure of first-line antibiotic therapy, a diagnostic bronchoscopy was performed with bronchial washings. Cultures were noted for *C. koseri* with susceptibility to all tested antibiotics, except ampicillin–sulbactam. Cytology revealed inflammatory cells without evidence of malignancy. HIV-1/2 screening tests and CD4 and other T-cell subset counts were unrevealing. Interestingly, serum IgG level was mildly reduced to 685 mg/dL (normal range = 767–1390 mg/dL), but IgA and IgM levels were normal. He was treated with a 14-day course of cefpodoxime, and defervescence and improvement in his cough were observed. His pulmonary emboli were additionally treated with low molecular weight heparin. Unfortunately,
following the conclusion of antibiotic therapy, his dyspnea continued to progress. Repeat bronchoscopy for evaluation of ongoing infection revealed patchy, thickened, erythematous, endobronchial lesions involving the right upper lobe with gross endobronchial obstruction (Fig. 3). Endobronchial biopsy was significant for pulmonary adenocarcinoma.

Discussion

*C. koseri* has been traditionally isolated from elderly debilitated patients with a significant underlying disease and is most commonly known to cause urinary tract infections. Mohanty et al. found that 181 out of 205 *Citrobacter* spp. infections occurred in patients who were immunocompromised or had significant known underlying disease in a hospital in Northern India during 2004. The literature review yielded only a single case of community-acquired pneumonia in a healthy adult. To our knowledge, no cases have been reported of lung cancer presenting with coexistent *C. koseri* pneumonia; although, chronic lung disease, malignancy, and hypogammaglobulinemia predispose to opportunistic pulmonary infections. Moreover, the fact that the patient's fever, productive cough, and leukocytosis resolved with appropriate IV antibiotics favors a true *C. koseri* pneumonia rather than airway colonization.

*Citrobacter* spp. are most commonly transmitted nosocomially via the hands of healthcare workers but are ubiquitous in the water, soil, and gastrointestinal tract of human beings. Interestingly, while our patient did not have recent nosocomial contact, he was actively working at numerous construction sites. The underlying malignancy has been correlated with severe *Citrobacter* infection. Patients with acute leukemia, neutropenia, and those undergoing cytotoxic chemotherapy appear to be at the highest risk, but solid tumors have also been associated. Multi-drug resistance is another notable feature of *Citrobacter* spp. as the organism has been known to produce extended-spectrum beta-lactamases. Therefore, ensuring antimicrobial susceptibility and initial broad-spectrum antibiotic coverage is important when considering therapy.

Pulmonary infection caused by *C. koseri* without an underlying disease process is a rare event. Diagnosing this infection should prompt further investigation for immunodeficiency and/or intrapulmonary pathology or neoplasm. This case highlights the significance of considering an underlying disease process for previously healthy individuals presenting with opportunistic pulmonary infections. Prompt diagnosis and appropriate treatment of both the infection and underlying disease process is key to improving patient outcomes.
Author Contributions
Conceived and designed the experiments: KP, MV, PE. Analyzed the data: KP, MV, PE. Wrote the first draft of the manuscript: KP. Contributed to the writing of the manuscript: MV, PE. Agree with manuscript results and conclusions: KP, MV, PE. Jointly developed the structure and arguments for the paper: KP, MV, PE. Made critical revisions and approved final version: KP, MV, PE. All authors reviewed and approved of the final manuscript.

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