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Legionella Causing Lung Abscess in an Immunocompetent Patient

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Abstract *Legionella* lung abscess (LLA) is known to develop from pneumonia and Legionnaires' disease in immunocompromised patients and aspiration. Literature review showed reports of aspiration pneumonia in immunocompetent patients; however, no such was found between LLA and immunocompetency. A 53-year-old male with history of depression and paraumbilical hernia presented for chest pain, which was right sided, started acutely, constant, radiated to the back, and exaggerated with taking deep breaths. The patient denied all other symptoms. Social history was only pertinent for being an active 35 pack-year smoker. The patient was recently admitted one month ago for viral meningitis from *Echovirus*. On physical exam, the patient was vitally stable, had absent breath sounds in the right middle lobe, and was significantly tender at the right anterior chest. Labs revealed elevated sedimentation rate and C-reactive protein. Imaging demonstrated a right middle lobe lung abscess. Throughout the hospital course, *Legionella pneumophila* serogroup 1 (LPS1) was found to be positive on urine antigen, sputum polymerase chain reaction, and sputum cultures. The patient was switched to intravenous levofloxacin and ampicillin-sulbactam. Upon symptomatic resolution, the patient was discharged home with recommendations for a follow-up chest computed tomography and diagnostic bronchoscopy. We hypothesize that smoking causes neutrophilic stasis within the lung and the development of the LLA. Treatment includes intravenous long term antibiotics and possibly drainage.

Keywords: *case report, Legionella pneumophila infection, lung abscess, Immunocompetence, cigarette smoking*

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1. Introduction

Legionella commonly presents as community acquired interstitial pneumonia and sometimes as Legionnaires' disease. From these, a *Legionella* lung abscess (LLA) can develop. Those at high risk are immunocompromised patients, such as chronic steroid therapy, cellular immunodeficiency, and immunomodulatory treatment. Aspiration pneumonia is a common etiology of lung abscesses. However, they usually present in patients with periodontal disease, seizures, alcohol abuse, or dysphagia. Aspiration pneumonia is usually seen with a mixture of anaerobic and aerobic organisms, including *Legionella* [1,2,3,4,5]. After extensive literature review, we report the first case of a LLA occurring in an immunocompetent patient.

The pathogenesis of emphysema has been described as smoking causing a neutrophilic stasis within the lung parenchyma. [6] We propose that our patient had a similar presentation that eventually progressed to a LLA. Treatment guidelines for LLA are intravenous antibiotics for four-six weeks and if abscess does not resolve, drainage should be considered [1].

2. Case Presentation

A 53-year-old male presented to the emergency department for chest pain. The patient has a medical history of depression and paraumbilical hernia with repair. In regards to the chest pain, it was localized to the right sided and acutely started six hours prior to admission. The patient described it as constant, dull, achy, radiated to the back, and exaggerated with movement, coughing, and taking deep breaths. The patient denied having fever, chills, night sweats, weight loss, occupational exposures, or recent travel. He also denied any history of immunodeficiency (congenital or acquired), intravenous drugs, incarceration, or contact with someone infected with tuberculosis. The patient admitted to a recent hospitalization for viral meningitis that was one month before the current presentation. He was treated with intravenous vancomycin, ceftriaxone, and acyclovir, but they were discontinued when the cerebrospinal fluid polymerase chain reaction (PCR) was positive for *Echovirus*. After clinical improvement, he was discharged and denies recurrence of symptoms. Social history

revealed he was an active 35 pack-year smoker and worked in sales.

On presentation, the patient was afebrile at 98.7°F, 140/81 mmHg, tachycardic 102 bpm, tachypneic 24 rpm, and with oxygen saturation of 98% on room air. He appeared in significant distress from severe chest pain. On physical exam, he was significantly tender to palpation at the right anterior chest, specifically between the third and sixth ribs at the midclavicular and midaxillary lines. Auscultation revealed absent breath sounds in the right middle lobe. Due to the tenderness, percussion was not performed. Neurological, cardiovascular, abdominal, and pelvic examination was unremarkable. Laboratory investigations showed elevated sedimentation rate and C-reactive protein. No leukocytosis was seen, but there was a neutrophil predominance. Electrocardiogram showed a normal sinus rhythm. A comprehensive respiratory infectious work-up and echocardiogram was ordered (Table 1). The patient was given intravenous morphine for pain control. Chest x-ray illustrated a cavitary lung lesion in the right middle lobe. A chest computed tomography (CT) with contrast demonstrated a large cavitary lung lesion in the right middle lobe with thin-walled lucency and an air-fluid level (Figure 1).

Table 1. Laboratory and Microbiology Investigations

Laboratory investigation (Reference Range)	Value
White blood cells (10^3/uL)	7.5
Neutrophil (%)	89.3
C reactive protein (mg/dL)	6.3
Sedimentation rate (mm/h)	42
Sputum DNA PCR	LPS1
Legionella pneumophila urine antigen	Positive
Sputum culture on BYCE agar	LPS1
LPS1 Serum IgM	1:256 ratio
Methicillin-resistant Staphylococcus aureus	Negative
Respiratory sputum culture	Oropharyngeal flora
Blood culture	No growth x2/2
Atypical pneumonia panel	Negative
Streptococcus pneumonia urine antigen	Negative
Mycoplasma pneumonia urine antigen	Negative
Interferon-gamma release assay	Negative
Respiratory viral panel	Negative
HIV antigen-antibody combo	Negative
Fungal culture	No growth
Echocardiogram	Negative for valvular vegetations

Abbreviations: BYCE (Buffered Yeast Charcoal Extract), DNA (Deoxyribonucleic Acid), IgM (Immunoglobulin M), LPS1 (*Legionella Pneumophila* Serotype 1), PCR (Polymerase Chain Reaction).

Due to the recent hospitalization one month prior to this admission, we initiated broad spectrum antibiotics with vancomycin, levofloxacin, and piperacillin-tazobactam to cover for hospital acquired pneumonia. On the second day of hospitalization, *Legionella* urine antigen was positive for *Legionella pneumophila*. On day three of the hospital course, the sputum deoxyribonucleic acid PCR was also positive for *Legionella pneumophila* serogroup one (LPS1). Additionally, sputum culture on *Legionella* specific buffered charcoal yeast extract agar grew LPS1 on day six. Based on culture sensitivities, the patient was switched to intravenous levofloxacin along with ampicillin-sulbactam for empiric anaerobic coverage (Table 1).

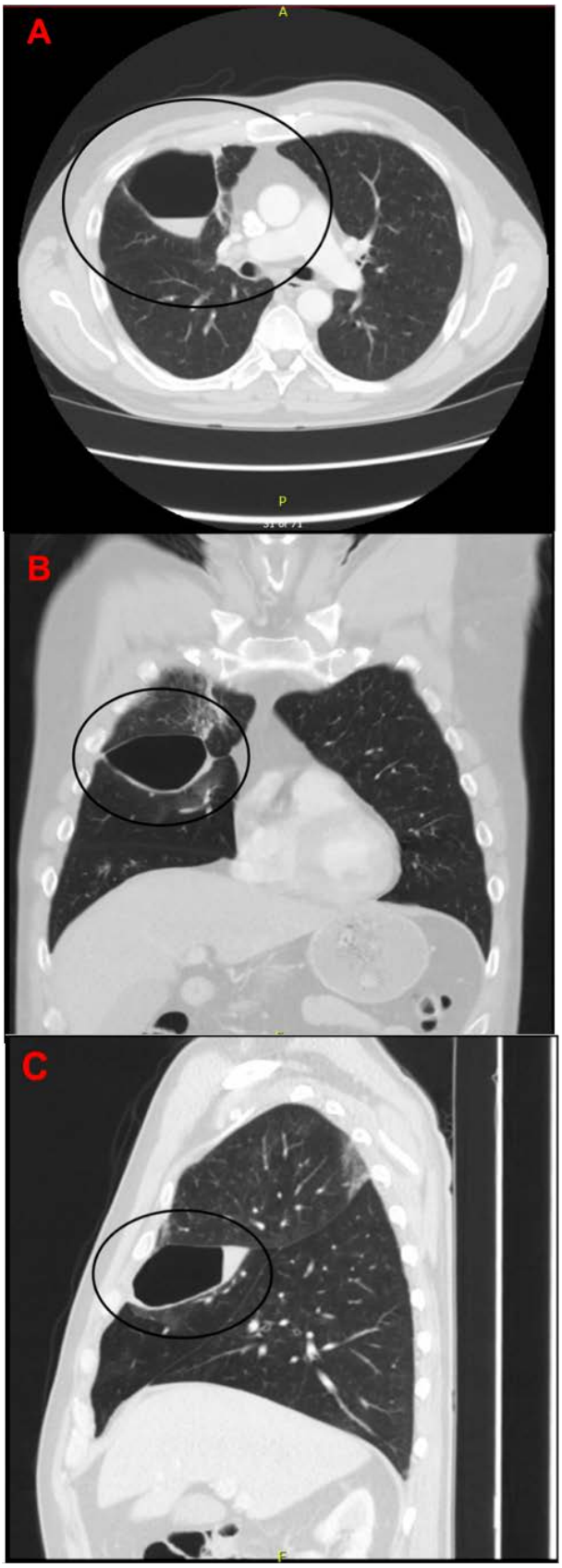

Figure 1. Admission chest computed tomography of Panel A) Coronal view, Panel B) Axial view, Panel C) Sagittal view. Cavitary lung lesion in the right middle lobe with thin-walled lucency and an air-fluid level, measuring 8.0 x 4.9 cm, indicated by the circle. No emphysematous changes or infiltrates seen.

Infectious disease recommended four weeks of intravenous ampicillin-sulbactam and oral levofloxacin. Therefore, a peripherally inserted central catheter (PICC) was placed and the patient was discharged home after clinically improving. We provided resources and counseling for smoking cessation. He was also recommended to follow-up in six-eight weeks with infectious disease for a chest CT and pulmonology for a diagnostic bronchoscopy, to ensure resolution of lung abscess and rule out cancer. The patient states his symptoms have fully resolved and he completed the antibiotic course. Follow-up chest CT was completed three months after antibiotic completion and showed resolution of the lung abscess (Figure 2). Additionally, the patient did not follow-up with pulmonology.

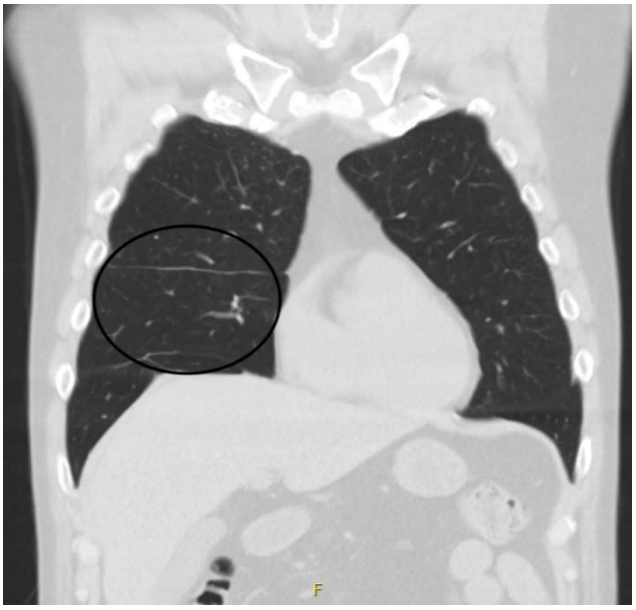

Figure 2. Follow-up chest computed tomography, Coronal view**.** Previous right middle lobe cavitary lung lesion is now resolved. Circle indicates where previous lesion was

3. Discussion

Legionella is an aerobic gram-negative bacteria that is found in hot water and soil. The most common species in humans are *Legionella pneumophila* and *Legionella micdadei*. The risk factors for *Legionella* include immunocompromised status, advanced age, smoking, and underlying pulmonary pathology [1,2,3,4,5]. *Legionella* commonly presents as community acquired pneumonia with a diffuse multilobar interstitial pneumonia. It may cause Legionnaires' disease in some cases, which is recognized by its symptoms of non-segmental lobar consolidation, Pontiac fever, pleural effusion, diarrhea, and hyponatremia from acute interstitial nephritis [2]. Although rare, these infections can progress and form a lung abscess, usually in immunocompromised patients [6]. We conducted an extensive PubMed search using the following keywords: 1) *Legionella* or aspiration; 2) abscess, cavity, or cavitary; and 3) immunocompetent, non-immunocompromised, or non-immunosuppressed. There are reports of immunocompetent patients developing aspiration pneumonia, but they were all non-*Legionella* species [7,8,9,10]. However, upon finding none with LLA, we report the first LLA case in an immunocompetent host.

A study analyzed 79 cases of LLA. The most common organism isolated was LPS1 at 82.3% The other organisms were *Legionella pneumophila* serogroups three-six, *Legionella micdadei*, *Legionella bozemanii*, *Legionella dumoffii*, and *Legionella maceachernii*. The majority of the patients had a history of steroid use (69.4%), cellular immunodeficiency from various etiologies, or taking post-transplant immunomodulators [6]. Other risk factors are chemotherapy for malignancy and acute neutropenic episodes after an acute infectious/inflammatory process [4,11,12,13,14,15]. The proposed pathogenesis of the abscess was poor cell-mediated immunity along with decreased chemokine and lymphokines signaling. This leads to relative lymphopenia with neutrophil accumulation and stasis in the lung tissue. Eventually, proteases and elastases are released and degrade the lung parenchyma that forms a lung abscess [6].

The typical etiology of lung abscess is via aspiration of oropharyngeal contents. Patients at high risk usually have either periodontal disease, seizures, alcohol abuse, or dysphagia. Infrequently, an infectious pneumonia may progress to lung parenchymal necrosis and abscess. Anaerobic bacteria are classically predominant, especially Streptococcus anginosus, but can also be Peptostreptococcus, Prevotella, Bacteroides, and Fusobacterium. However, a mixture of aerobic and anaerobic organisms have also been implicated. The aerobic organisms are typically Pseudomonas aeruginosa or Klebsiella pneumoniae. Moreover, an abscess may develop from a tumor obstructing the bronchus, infective endocarditis, or tuberculosis [1,2,3,4,5]. Our patient did not present with any of the above risk factors or etiologies on his history and work-up.

Our patient was unique as his history did not indicate any risk factors of being immunocompromised or having a cell-mediated immunity deficit. He was, however, an active smoker. Reports have associated smoking with neutrophilic stasis within the lung parenchyma and the development of emphysema [16]. We hypothesize that the neutrophilic stasis due to the smoking during emphysema is similar to that during *Legionella pneumonia*. Furthermore, we recommend that a patient with risk factors for developing intra-parenchymal neutrophilia within the lungs, careful consideration should be given for future development of an abscess.

Legionella pneumonia, Legionnaires' disease, and LLA require a regimen of antibiotics. The American Thoracic Society recommends fluoroquinolones, macrolides, tetracyclines, and a potent antipseudomonal B-lactam [13,14,15,16,17]. While, the first two infections can be dealt with short term duration; the course for LLA is four weeks with confirmation of cavity resolution. In our patient, we chose intravenous levofloxacin based on culture sensitivities along with ampicillin-sulbactam for empiric anaerobic coverage. Drainage is recommended for abscesses that are refractory to 12 weeks of appropriate antibiotics, size greater than six centimeters, loculation, and concurrent empyema. Possible drainage methods are bronchoscopically with a laser, percutaneous transthoracic tube drainage, chest tube drainage, or surgical resection [1].

4. Conclusion

Legionella infections, pneumonia and Legionnaires' disease, can eventually cause a lung abscess. However, LLA is typically seen in immunocompromised patients (chronic steroid therapy, cellular immunodeficiency, and immunomodulatory treatment) and aspiration. We present a 53-year-old immunocompetent male who developed a right middle lobe lung abscess from LPS1. This is the first reported case of LAA in an immunocompetent host. We associated the LLA to be from his smoking, causing neutrophilic stasis within the lung. Treatment includes long term intravenous intravenous antibiotics and possibly drainage.

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