Empyema Versus Lung Abscess: A Case Report

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Abstract
Lung abscesses and empyemas are 2 forms of pulmonary infection that can present with similar clinical features. However, empyemas are associated with higher morbidity and mortality, necessitating the need to distinguish one from the other. Plain radiographs can sometimes provide clues to help differentiate the 2 pathologies but more often than not, a computed tomography scan is required to confirm the diagnosis. Correct diagnosis is essential, as the goal standard therapeutic intervention for empyemas may be contraindicated in patients with lung abscesses. Empyemas require percutaneous or surgical drainage in combination with antibiotics, while lung abscesses are generally treated with antibiotics alone as drainage can be associated with various complications. We present a case of a 65-year-old man with parapneumonic empyema diagnosed with characteristic findings on chest computed tomography and treated with surgical drainage and antibiotics. We hope to improve patient outcomes by highlighting the classical radiographic findings that help distinguish empyema and abscess.

Keywords
pulmonary critical care, empyema, lung abscess, computed tomography, split pleura sign

Introduction
Empyema is a collection of pus within the pleural space emerging from pyogenic pathogens via direct inoculation or adjacent pneumonia.1 National data show a 2.0-fold increase in parapneumonic empyema-related hospitalizations from 1996 to 2008 with a mean in-hospital case fatality ratio of 7.6%.2 A close imposter of empyema is a lung abscess, a circumscribed purulent infection confined within the lung parenchyma.3 Patients with a primary lung abscess have a significantly better prognosis with a cure rate of 90% to 95% with appropriate antibiotic therapy and a mortality rate of just 0.01%.4 Unlike empyema, surgical intervention is typically only reserved for failed medical management.4 It is critical to differentiate the 2 pathologies promptly as delay in the management of empyema is associated with increased morbidity and mortality.5 We present a case of a patient with a lower respiratory tract infection complicated by parapneumonic empyema accurately diagnosed with imaging. The purpose of this article is to reveal the limitations with plain radiographs and to review the key imaging findings that make computed tomography (CT) the superior imaging modality of choice when attempting to discriminate empyema from abscess.

Case Presentation
Our patient is a 65-year-old man with a medical history significant for well-controlled hypertension, hyperlipidemia, and severe peripheral arterial disease with extensive history of angioplasty that presented to the emergency department with a 2-week history of malaise in the setting of a nonproductive cough and low-grade fevers. Over the week prior to presentation, the patient started experiencing localized right upper quadrant pain that worsened with coughing. His symptoms progressed to constant dyspnea on exertion. On presentation, the patient was found to be hemodynamically stable, afebrile, and saturating 94% while breathing in room air. Physical examination was significant for a well-developed, well-nourished male in no apparent distress. Pulmonary examination was significant for borderline decreased chest rise on the right
hemithorax. Auscultation revealed decreased airway entry in the right mid and lower zones as well as harsh crackles. The rest of the physical examination was otherwise unremarkable. Social history was significant for an 80-pack-year smoking history as well as work-related exposure to asbestos.

Biochemistry laboratories revealed leukocytosis with neutrophilic predominance, as well as thrombocytosis thought to be reactive in nature. A COVID-19 panel was negative by polymerase chain reaction and procalcitonin was elevated to 1.39 ng/mL (ref < 0.50 ng/mL). A chest radiograph, as seen in Image 1 below, revealed a moderate-sized pleural effusion on the right side.

The patient was admitted for suspected community-acquired pneumonia and for further investigation into causes of dyspnea in the setting of a unilateral pleural effusion. He was initially treated with intravenous (IV) ceftriaxone and azithromycin as he lacked any high-risk features. A repeat chest radiograph was ordered on hospital day 2 due to persistent fevers and a lack of improvement in symptoms despite IV antibiotics. Imaging at this time revealed worsening progression of the effusion, prompting a CT scan of the chest without contrast to be performed which ultimately revealed a large empyema with substantial compression of the right lung as seen in Images 2 to 4.

Based on these new findings, the patient was evaluated by thoracic surgery and subsequently underwent video-assisted thoracoscopic surgery (VATS) due to the large cavity size of the empyema. The parapneumonic fluid was drained and cultures were obtained which came back positive for streptococcus constellatus. The patient improved significantly after this intervention and was discharged on a 3-week course of cefuroxime 500 mg twice daily. The patient was seen in the clinic 4 weeks later and reported complete resolution of his symptoms.

**Discussion**

A lung abscess typically presents with a few days of fever, along with chest pain and purulent sputum production. A plain radiograph of the chest is often the initial imaging modality of choice in the work-up of a suspected infectious lung process and can provide some limited preliminary information as to the underlying cause. A lung abscess often will appear uniformly round and can form an acute angle with the chest wall as compared to an empyema which is usually lentiform in shape and is known for forming more of an obtuse angle with the costal surface. While a chest X-ray can be helpful, the sensitivity and specificity of these findings for differentiating a pulmonary abscess from an empyema are lacking and can result in an incorrect diagnosis. Thoracic CT, on the contrary, is a highly effective diagnostic tool and the preferred modality to differentiate these 2 lung pathologies. One study by Stark et al revealed that CT alone was sufficient to correctly diagnose 100% (70/70) of inflammatory thoracic lesions as either lung abscesses or empyemas. The most reliable features on imaging tend to be wall characteristics, amount of lung compression, and the presence of pleural separation. On CT, lung abscesses characteristically have thick irregular walls that rarely compress the adjacent lung with minimal pleural enhancement.

The typical presentation of an empyema is very similar to that of a lung abscess in that patients will frequently report fever, chest pain, and cough with possible sputum production. Since there is overlap in symptomatology, imaging is crucial in identifying a lung abscess from an empyema. On chest X-rays, empyemas may have the classic lenticular shape and obtuse angle formation with the adjacent wall, but this pattern alone should not guide clinical judgment and a thoracic CT should be
the next diagnostic tool to distinguish these 2 clinical conditions. Key initial characteristic features to look for are the thinner walls and smoother lumen of an empyema. In addition, empyemas are known to compress lung parenchyma. Furthermore, empyemas can result in fluid buildup directly in the pleural space, leading to separation, thickening, and increased enhancement of the 2 pleural layers which produces the hallmark imaging finding known as the split pleura sign.

Distinguishing a lung abscess from an empyema is of therapeutic importance as the clinical management of each differs. Lung abscesses tend to be treated with a prolonged course of IV antibiotics and chest physiotherapy to promote postural drainage. Empyemas often require an interventional approach to drainage with chest tube insertion under ultrasound guidance typically being the first attempted treatment with mixed data regarding the success of augmenting with intrapleural fibrinolytic administration to reduce fluid viscosity by breaking down the fibrous adhesions. Sometimes, more invasive surgical measures including VATS or open drainage are utilized in patients that fail initial chest tube drainage or have large empyemas with loculated fluid that would unlikely be adequately drained with tube thoracostomy alone. Regardless of the exact interventional method of removing fluid in empyemas, the principle is the same: draining the pleural cavity to allow full expansion of the compressed lung. However, this same interventional treatment approach for lung abscesses carries high risks and should only be reserved for select circumstances. Accidentally inserting a chest tube into a pulmonary abscess can result in a multitude of complications including the development into empyema, pneumothorax, hemorrhage, and the creation of a bronchopleural fistula. Therefore, drainage of a lung abscess with a chest tube or other surgical intervention is typically only considered in limited situations, such as those who fail medical therapy, as there is the potential for prolonging infection by seeding into the pleura, in addition to the high mortality that comes with some of these procedural complications like bronchopleural fistula.

The patient we presented reported symptoms of a lower respiratory tract infection including a 2-week history of fever, dyspnea, pleuritic chest pain, and cough productive of purulent sputum. An initial chest X-ray raised concerns of a right lower pneumonia due to the presence of a moderately sized pleural effusion which was treated with appropriate antibiotics. However, the patient reported persistent symptoms and a follow-up chest X-ray failed to reveal resolution, leading to a noncontrast CT scan of the chest which favored the diagnosis of empyema. The findings we noted to support our diagnosis included the thin wall of this mass, paired with an overall smooth internal lumen (Image 2). As commonly demonstrated by empyemas, significant mass effect was also noted with the mass seen completely collapsing a large portion of the right lung (Image 3). Finally, we also noted another hallmark feature on CT scan known as the split pleura sign with the empyema visually separating the 2 pleural layers (Image 4). The combination of these highly characteristic findings on the patient’s chest CT overwhelmingly pointed to empyema as the source of his symptoms which we were able to successfully resolve with video-assisted surgical drainage and a prolonged duration of antibiotics.

**Conclusion**

Our case highlights the importance for clinicians to understand the radiographic findings that distinguish a lung abscess from an empyema, especially since the approach to fluid drainage in each condition varies drastically, and there are risks associated with incorrectly draining lung abscesses through surgical interventions. It is not sufficient to solely rely on chest X-ray features to differentiate a pulmonary abscess from an empyema as this can lead to an incorrect diagnosis. A CT scan is the superior imaging modality of choice and should be considered when patients fail to improve on antibiotic therapy. Furthermore, we hope to use this case as a framework to
educate clinicians on the multiple radiographic findings a thoracic CT can provide that when taken together, and in the correct clinical setting, can help correctly distinguish these 2 similarly presenting pulmonary infections.

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Our institution does not require ethical approval for reporting individual cases or case series.

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