A Case of Thoracic Empyema Caused by *Actinomyces naeslundii*

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**Patient:** Male, 39-year-old  
**Final Diagnosis:** *Actinomyces* empyema  
**Symptoms:** Back pain • fever  
**Clinical Procedure:** —  
**Specialty:** Pulmonology • Surgery

**Objective:** Rare disease  
**Background:** Actinomycosis is a clinically significant but uncommon infectious disease caused by anaerobic commensals of *Actinomyces* species, and the incidence of thoracic empyema is rare. We report an extremely rare case of empyema caused by *Actinomyces naeslundii* (*A. naeslundii*).

**Case Report:** A 39-year-old man presented to our hospital with fever and dyspnea. He had massive pleural effusion and was diagnosed with a left lower-lobe abscess and left thoracic empyema. Thoracic drainage was performed and Ampicillin/Sulbactam was administered for 3 weeks. Four years later, the patient presented with back pain, and chest X-ray showed increased left pleural effusion. After close examination, malignant pleural mesothelioma was suspected, and computed tomography-guided needle biopsy was performed, which yielded a viscous purulent pleural effusion with numerous greenish-yellow sulfur granules. *A. naeslundii* was identified through anaerobic culture. Thoracoscopic surgery of the empyema cavity was conducted, and Ampicillin/Sulbactam followed by Amoxicillin/Clavulanate was administered for approximately 6 months. No recurrence has been observed for 1 year since the surgical procedure.

**Conclusions:** *Actinomyces* empyema is a rare condition, and this case is the second reported occurrence of empyema caused by *A. naeslundii*. The visual identification of sulfur granules contributed to the diagnosis. Long-term antibiotic therapy plays a crucial role in treatment.

**Keywords:** *Actinomyces naeslundii* • Actinomycosis • Empyema, Pleural

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Background

Actinomycosis is an infrequent but clinically important chronic granulomatous disease caused by anaerobic commensal bacteria of the *Actinomyces* genus in the oral cavity and gastrointestinal tract [1]. Notably, actinomycosis can cause fibrosis, fistulas, or abscesses, thereby amplifying its clinical significance. Most cases of thoracic actinomycosis involve the pulmonary parenchyma, pleura, and chest wall, with the occurrence of thoracic empyema being uncommon [2]. Furthermore, empyema caused by *Actinomyces naeslundii* (*A. naeslundii*) is extremely rare, with only 1 case reported by Monroe et al in 1974 [3]. We present an extremely rare case of empyema caused by *A. naeslundii*.

Case Report

A 39-year-old man presented to our hospital with fever and dyspnea. He had a history of an 8-pack-years smoking history and occasional alcohol consumption. Furthermore, he had a medical background indicating bronchial asthma and a mild form of periodontal disease. Chest X-ray revealed significant left pleural effusion, while chest computed tomography (CT) demonstrated a low-attenuation area within the atelectasis of the left lower lobe (Figure 1A). Laboratory data indicated leukocytosis (24.83×10^3/μL) and elevated C-reactive protein (CRP 32.04 mg/dL). He was diagnosed with a left lower-lobe lung abscess and thoracic empyema, and subsequently underwent thoracic drainage. The pleural fluid culture yielded negative results. Empirical treatment was initiated with Ampicillin/Sulbactam (ABPC/SBT) at a dosage of 12 g/day, alongside pleural lavage. After 2 weeks, the chest tube was removed following improvements in leukocytosis and C-reactive protein levels. The antibiotic was changed to Amoxicillin/Clavulanic acid (AMPC/CVA) at a dose of 750 mg/day, and he was discharged. One week later, although a small residual empyema cavity was still evident on chest X-ray, the antibiotic course was completed.

Four years later, the patient visited a clinic due to back pain that had persisted for a month. Chest X-ray revealed increased left pleural effusion, resulting in referral to our hospital. Chest CT revealed a mass with pleural thickening and an internal low-attenuation area at the site of the previous empyema cavity (Figure 1B). Given the suspicion of malignancy or lymphoma, positron emission tomography-CT was conducted, revealing enhanced 18F-fluorodeoxyglucose uptake in the mass with a maximal standardized uptake value of 18.61 (Figure 2). Laboratory data demonstrated no elevation in leukocytes (10.92×10^3/μL), CRP (1.10 mg/dL), carcinoembryonic antigen (1.2 ng/mL), or soluble interleukin-2 receptor (445 U/mL). Based on the aforementioned findings, malignant pleural mesothelioma was suspected, prompting CT-guided needle biopsy. The initial histopathological examination revealed granulation tissue with collagenic fibers, without apparent malignant cells. Consequently, another CT-guided needle biopsy was performed, involving puncture of the low-attenuation area, which yielded a viscous purulent pleural effusion containing greenish-yellow sulfur granules (Figure 3A). Histopathological examination confirmed the presence of inflammatory cell infiltration surrounding the actinomycotic granules (Figure 3B). Additionally, *A. naeslundii* was identified through anaerobic culture, establishing the diagnosis of thoracic empyema caused by *A. naeslundii*. The minimum inhibitory concentration of ABPC/SBT was 1.0 mg/L, and AMPC/CVA was 0.5 mg/L. Antibiotic therapy was initiated with AMPC/CVA.
at a dose of 750 mg/day. Two weeks later, contrast-enhanced CT revealed a small low-attenuation area within the thickened pleura (Figure 4). Due to the slight reduction in size of the empyema cavity compared with pre-treatment CT, thoracoscopic surgery was performed. The parietal and visceral pleura presented with hard thickening, impeding adequate decortication of the empyema cavity. Following the partial decortication, and with debridement of the empyema cavity achievable, a chest tube was inserted. On the day of surgery, the antibiotic was switched to intravenous ABPC/SBT at a dosage of 6 g/day, and the chest tube was removed the following day. After 2 weeks, the antibiotic was switched to oral AMPC/CVA at a dose of 750 mg/day again, and the patient was discharged from the hospital. AMPC/CVA was continued for approximately 6 months. At present, 1 year has passed since the surgery, and no evidence of recurrence has been observed thus far.

Discussion

Actinomycosis commonly affects the cervicofacial and abdominopelvic organs [1]. Thoracic involvement is less frequent,
accounting for approximately 10-20% of cases. Among the Actinomyces species implicated in human disease, Actinomyces israelii (A. israelii) is the most commonly identified, whereas A. naeslundii is detected in only 7% of actinomycosis cases [4]. Remarkably, there is only 1 documented instance of A. naeslundii thoracic empyema, reported in 1974 [3]. Thoracic actinomycosis typically arises following inhalation or aspiration of endogenous microorganisms from the oropharynx into the lungs in patients with poor oral hygiene, or through cervical extension [5]. Risk factors include dental caries, periodontal disease, diabetes mellitus, malignancy, immunodeficiency, and heavy alcohol consumption. In our case, the patient had mild periodontal disease, which precipitated the development of a lung abscess and subsequently progressed to empyema.

The diagnosis of actinomycosis is difficult and often delayed due to nonspecific clinical manifestations. A definitive diagnosis necessitates the culturing and identification of Actinomyces species. Histological examination revealing Gram-positive bacteria and sulfur granules supports a diagnosis of actinomycosis [6]. Special attention should be given to handling of the specimens. After collection, a specimen should be promptly preserved under anaerobic conditions and cultured under controlled conditions of 6-10% carbon dioxide at 37°C [7]. Due to the slow-growing nature, extended anaerobic incubation of culture is necessary for a duration of up to 3 weeks. From a pathological perspective, actinomycotic granulomas, frequently containing sulfur granules, exhibit intricate arrangements of filaments and club-shaped structures, accompanied by a granulomatous periphery consisting of fibroblasts, plasma cells, giant cells, and polymorphonuclear leukocytes [1]. Microscopically, sulfur granules appear as round basophilic masses with club-shaped eosinophils arranged radially on the surface [1]. While sulfur granules may be macroscopically visible, we could not find any reports that included a visual representation of sulfur granules. However, we should be vigilant in identifying sulfur granules microscopically, as this could provide crucial information for a definitive diagnosis.

As Actinomyces empyema is a rare condition, there is no established standard treatment. Shimoda et al [12] reported that the median duration of antibiotic therapy for Actinomyces empyema is 16 weeks, compared with 4 weeks for typical empyema. This finding suggests that Actinomyces empyema necessitates prolonged treatment with antibiotics. In addition, 75% of cases were successfully treated with antibiotics and thoracic drainage, while only 15.8% required surgery, thereby suggesting a minimal necessity for surgical treatment and emphasizing the essential nature of long-term antibiotic therapy. In our case, antibiotic therapy and thoracic drainage were performed initially. However, since Actinomyces could not be identified at that time, the duration of antibiotic therapy was insufficient, consisting of only 2 weeks of intravenous treatment and 1 week of oral therapy. Consequently, the empyema cavity persisted and gradually recurred over a period of 4 years. Upon recurrence, the presence of an unusual causative bacteria and the potential limited antibiotic penetration within the chronic empyema cavity prompted the decision for surgery. It is considered that surgical intervention was ineffective as the empyema cavity had become hardened, making decortication difficult to perform. Furthermore, given that preoperative antibiotic administration yielded a slight decrease in the empyema cavity, surgical intervention may have been unnecessary. There is a possibility that administering antibiotics intravenously, rather than orally, at the time of diagnosis could have avoided the need for surgical intervention.

**Conclusions**

Actinomyces empyema is a rare condition, and this case represents the second reported instance of empyema caused by A. naeslundii.
The visual identification of sulfur granules contributed to the diagnosis; however, it is important to exercise caution due to the difficulty associated with culturing Actinomyces species. Long-term antibiotic therapy plays a crucial role in the treatment of actinomycosis.

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