



# Thoracic Actinomycosis with Empyema Necessitans: Successful Enteral Antimicrobial Therapy after Pathologic Diagnosis from Superficial Chest Wall Biopsy

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## Abstract

A 10-year-old female presented with cough and an anterior chest wall mass and was diagnosed with thoracic actinomycosis and empyema necessitans based on soft tissue biopsy. Oral antimicrobial therapy was used exclusively instead of an initial intravenous course with complete resolution of symptoms and substantial improvement of radiographic findings.

**Keywords:** Thoracic actinomycosis; Empyema necessitans; Enteral antimicrobial therapy

## Introduction

Thoracic actinomycosis is a rare, invasive bacterial disease most commonly caused by *Actinomyces israelii*, a gram positive filamentous branching bacilli. Pulmonary infection can present with pulmonary abscesses, empyema, or pleurodermal sinus tracts [1]. Patients present with cough, shortness of breath, fever, and occasionally hemoptysis and can have a palpable chest wall mass on physical exam. Development of thoracic actinomycosis infection is commonly attributed to aspiration of oropharyngeal secretions. Actinomycosis is less common in children than adults, but identified risk factors in children include dental caries, trauma, debilitation, and diabetes mellitus [2-5].

Often the diagnosis of thoracic actinomycosis depends upon histopathologic examination of a biopsy sample. Gram positive filamentous branching bacteria at the periphery of a characteristic sulfur granule are suggestive of actinomycosis. The mainstay of treatment includes prolonged antimicrobial therapy, usually two to six weeks of intravenous penicillin G followed by oral penicillin for 6 to 12 months, though shorter successful courses have been reported [5]. *Actinomyces* also have *in vitro* susceptibility to other antibiotics including amoxicillin, doxycycline, and clindamycin, which have been used effectively [4]. Surgical resection may be indicated if the patient has extensive necrosis, sinus tracts, or fistulas [3]. The eventual need for surgical resection has been reported as high as 50% in thoracic actinomycosis [2].

## Case Presentation

A 10-year-old female presented to her primary care clinic with a cough and a non-tender lump on her chest wall. The cough had been ongoing for three weeks and was occasionally productive of scant clear sputum. Early in the course, she had one episode of blood-streaked sputum but denied frank hemoptysis. One week prior to presentation, her mother noted a palpable round lump on the right anterior chest. There were no reported fevers, but a three-pound weight loss was noted throughout the month prior to presentation. Her review of systems was otherwise negative.

The patient was born prematurely at 30 weeks gestational age in Mexico. Her medical history was significant for mild cerebral palsy, hearing loss, seizure disorder and developmental delay. She emigrated from Mexico to the United States at age 6 years and continued to visit Mexico twice annually since immigrating. During her visits to Mexico, she was routinely exposed to horses, cattle

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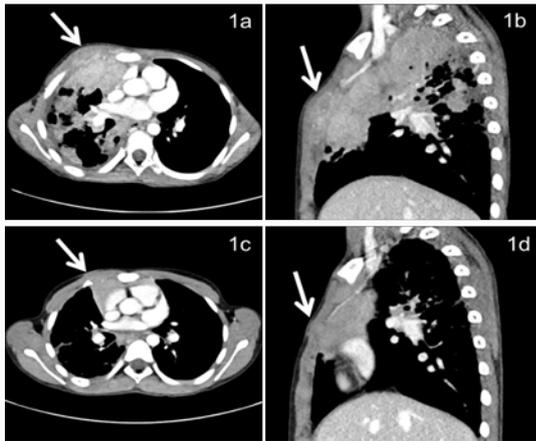
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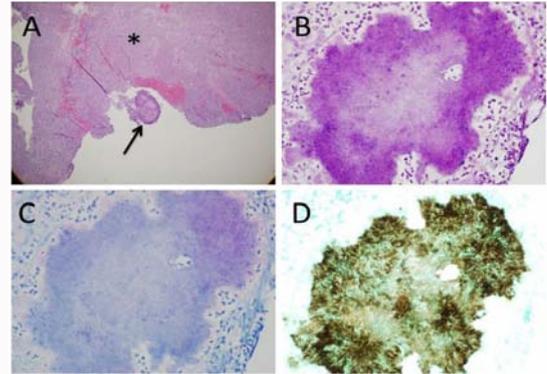
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**Figure 1:** Initial contrast-enhanced CT scans of chest with axial a) and sagittal. b) Images demonstrate an enhancing mass/consolidation centered within the right upper lobe with involvement of the right middle and right lower lobes and extension into the anterior chest wall (arrows) through the second and third rib interspaces and costochondral junctions. Repeat contrast-enhanced CT axial. c) and sagittal. d) Images after five months of oral antibiotic therapy demonstrate marked improvement in consolidation and anterior chest wall mass with only minimal soft tissue thickening in the region of the previous chest wall mass and right lung scarring and fibrosis (not shown).

and dogs on the family ranch. She had no known sick contacts and no close contacts with known tuberculosis. She received the BCG vaccine per parent report. She was otherwise up to date on vaccinations. There was no family history of rheumatologic or chronic pulmonary conditions.

On presentation, the patient’s vital signs were within normal limits including an oxygen saturation of 98% in room air. Physical examination revealed a thin girl with notable dental caries, mild scoliosis, increased muscle tone consistent with cerebral palsy, and a one centimeter mobile, non-tender right anterior cervical lymph node. Her respiratory examination was significant for diminished breath sounds in the right upper and lower lobes with scattered fine crackles noted throughout the right hemithorax with no increase in work of breathing. On her right anterior chest, she had a 5cm x 4cm smooth, firm, non-tender mass located in the second to third intercostal space. The remainder of her examination was unremarkable. Initial chest radiograph in clinic demonstrated an apical right upper consolidation with peribronchial thickening and slight volume loss suggesting atelectasis. Scoliosis surveillance radiographs from one year prior revealed a less pronounced right upper lobe consolidation that was not treated or investigated further at the time. Laboratory studies revealed leukocytosis, a normal metabolic panel, elevated Erythrocyte Sedimentation Rate (ESR) and C-Reactive Protein (CRP), normal lactate dehydrogenase, and low uric acid. That same day, the patient was empirically started on amoxicillin-clavulanate 20mg/kg orally three times per day for presumed pneumonia. Chest Computed Tomography (CT) scan with contrast was obtained one day later and showed a dense consolidation centered in the right upper lobe with partial involvement of the right middle and right lower lobes (Figure 1). The consolidation extended through the anterior chest wall between the second and third rib interspaces and costochondral junctions without evidence of osseous erosion, radiographically consistent with empyema necessitans. Given the concern for an infiltrative process associated with infection or malignancy, the patient was admitted for further diagnostic evaluation.



**Figure 2:** Pathology Slides from Superficial Chest Wall Biopsy. A) H&E stained histology showing soft tissue involved by extensive acute and chronic inflammation (\*), and scattered sulphur granules (arrow). B) Gram stain showing sulphur granules to consist of cluster of filamentous, beaded organisms, morphology characteristic of Actinomyces. C) Negative Fite stain (excluding Nocardia and mycobacteria). D) GMS stain highlighting same bacterial organisms seen in B, but negative for fungal organisms.

Flexible bronchoscopy with Bronchoalveolar Lavage (BAL) and soft tissue incisional biopsy of the external chest wall mass was performed one day after the CT scan. Flexible bronchoscopy revealed normal airway anatomy, without evidence of compression or erosion. BAL from the right upper lobe demonstrated neutrophilic inflammation, with 673 nucleated cells per mm<sup>3</sup>; 78% neutrophils, 17% lymphocytes, 2% macrophages and 3% alveolar macrophages. Gram stain, acid fast stain, and calcofluor fungal stain of the BAL fluid were all negative, as were BAL mycobacterial and fungal cultures. Aerobic bacterial culture from the BAL grew only 600 CFU/mL of mixed upper respiratory flora. Examination of Hematoxylin and Eosin (H&E) histology of the soft tissue biopsy sample demonstrated evidence of extensive acute and chronic inflammation and scattered sulfur granules (Figure 2a), morphologically consistent with *Actinomyces* organisms. Tissue gram stain revealed clusters of filamentous, beaded bacterial organisms (Figure 2b). Fite stain was negative, excluding the diagnosis of *Nocardia* or mycobacterial infection, and no fungal organisms were identified on Grocott’s Methenamine Silver (GMS) stain (Figure 2c,d). Importantly, no atypical or malignant cells were identified in the biopsy tissue. During the biopsy of her chest wall, an aspirated sample of purulent material was sent for aerobic, anaerobic, fungal, and mycobacterial cultures. Gram stain, calcofluor stain for fungus, and acid-fast stain of the aspirated purulence from the chest wall mass were negative. Anaerobic culture grew rare *Fusobacterium nucleatum*. *Actinomyces* species was not identified on culture, but determined to be the likely primary pathogen due to biopsy and radiographic findings. The *Fusobacterium* was determined to be a commensal anaerobic co-infection as is commonly seen with actinomycosis [5]. A tuberculin skin test done on admission was negative.

Concerns were raised regarding prolonged intravenous antibiotic therapy given the patient’s developmental delay and family plans to travel to Mexico following hospital discharge. The infectious diseases service was consulted, and the decision was made to initiate oral antimicrobial therapy with high dose amoxicillin 90mg/kg/day divided three times daily and clindamycin 10mg/kg/dose three times daily. It was felt that while amoxicillin would be the mainstay of treatment, the high oral bioavailability of clindamycin would offer high serum antibiotic levels to offset the lack of initial intravenous

antimicrobial therapy while also providing coverage for commensal oral anaerobic flora. Several weeks into treatment, her cough and the chest wall mass had resolved, and her ESR and CRP levels normalized. Repeat contrast-enhanced chest CT five months into treatment demonstrated marked improvement in the right upper lobe consolidation and chest wall mass. Chest CT was obtained again at nine months into treatment, revealing substantial interval decrease in the number of scattered cystic foci throughout the right lobe, indicative of ongoing disease resolution (Figure 1). The patient completed 6 weeks of clindamycin therapy with 12 months total of amoxicillin therapy. She has had no recurrence of symptoms to date after more than 6 months off antimicrobial therapy.

## Discussion

Thoracic actinomycosis is rare in children. A review conducted at Texas Children's Hospital in 2008 identified 55 cases of pediatric thoracic actinomycosis reported in the literature since 1975 [5]. The most common reported presenting sign in these cases was a chest wall mass (49%) as *Actinomyces* can cross tissue planes, followed by cough and chest pain. Risk factors for thoracic actinomycosis include neurologic impairment leading to increased aspiration risk and poor dentition, and our patient was both developmentally delayed and had dental caries.

The diagnosis of thoracic actinomycosis can be delayed given similar presentations of malignancy or tuberculosis [5]. Several published cases of thoracic actinomycosis describe initial concerns for malignancy leading to invasive evaluation, often including open thoracotomy or surgical resection [5]. A high index of clinical suspicion for actinomycosis may be helpful in reducing invasive evaluations in suspected cases. Initial concerns for malignancy in our patient led to a diagnostic superficial chest wall surgical biopsy, avoiding the need for a more invasive intra thoracic procedure.

In the management of thoracic actinomycosis, surgical resection is often indicated for extensive disease [2]. Historically, thoracic actinomycosis is treated initially with intravenous antimicrobials before transitioning to oral antimicrobial therapy, and current recommendations based on expert opinion similarly encourage intravenous antimicrobial therapy for treatment initiation. However, due to the risks of prolonged intravenous access in this patient, oral antimicrobial therapy was used exclusively. Reassuringly, our patient showed a positive response to oral antibiotics even in the absence of initial intravenous treatment. She completed a 12-month course of oral antibiotics with significant decrease of disease noted on repeat CT imaging and without the need for surgical resection to date. This case reinforces the need for further investigations to reevaluate the need for initial intravenous antimicrobials in the treatment of thoracic actinomycosis.

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