Thoracic Radiology

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Progressive Dyspnea and Back Pain after Complicated Pneumonia

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Case Vignette

A 56-year-old woman presented with 3 days of worsening dyspnea and pleuritic back pain. At 1 month before presentation, she had been diagnosed with necrotizing *Streptococcus pneumoniae* pneumonia complicated by a bronchopleural fistula requiring multiple chest tubes (with 1,100 ml purulent output in 72 h) and a left upper lobectomy. Physical examination was notable for multiple areas of subcutaneous swelling along the posterior left chest wall. In addition, there was a 1 × 1-cm

Figure 1. Anteroposterior chest radiograph shows increased density in the left hemithorax.

Figure 2. (A and B) Axial and (C) coronal images show a complex left pleural effusion. (A) An arrow points to fluid in the pleural space with an air fluid level visible superiorly. (B) Arrows demonstrate the two components of thickened pleura in the “split-pleura” sign. (C) An arrow identifies a defect in the left lateral thorax that allows communication into the extra-thoracic space.

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white pustule in the left lateral chest wall along the mid axillary line. Chest radiography (Figure 1) and computed tomography (CT) of the chest with intravenous contrast (Figure 2) were performed for further evaluation.

Questions

- 1. What are three imaging findings in Figures 1 and 2 that indicate a complex pleural collection?*
- 2. What is the most likely diagnosis of this patient?*
- 3. What is the most common cause of this entity?*

[Continue onto next page for answers]

Radiographic Findings

The anteroposterior chest radiograph (Figure 1) demonstrates a complex left pleural effusion and a large area of increased density external to the left hemithorax. Axial and coronal contrast-enhanced CT of the chest (Figures 2A–2C) show a large multiloculated left pleural effusion with air–fluid levels seen as loculations containing fluid dependently with a sharp demarcation between the fluid and the air above it (Figure 2A) and thickening of both visceral and parietal pleura (arrows in Figure 2B). The pleural effusion directly communicates with a large, complex fluid collection in the soft tissues outside the left thoracic cage that extends to the skin, with an obvious chest wall defect (arrow in Figure 2A) and intercostal fistula (arrow in Figure 2C).

Discussion

Definition

Empyema necessitans (EN) is a condition in which infected pleural fluid ruptures through the parietal pleura and drains into the overlying chest wall.

Etiology

EN most commonly results from inadequately treated or chronic empyema, often in immunocompromised patients. Recent thoracic surgery is a risk factor for EN, as infection can travel along a previously created surgical tract. The organism most commonly implicated is *Mycobacterium tuberculosis*, although other potential organisms include *Actinomyces*, *Fusobacterium*, *Staphylococcus aureus*, *Streptococcus pneumoniae*, *Streptococcus milleri*, and *Aspergillus*. Although nonspecific, some imaging characteristics on chest CT may suggest causative organisms in EN. Bony destruction with soft-tissue masses that exhibit rim enhancement and areas of calcification suggest tuberculosis. *Actinomyces* infection often results in draining sinus tracts and wavy periostitis. Cavity formation, pulmonary consolidation, and osteolytic changes of the rib and spine may be seen in invasive pulmonary aspergillosis. The patient's medical history and exposures guide suspicion for these organisms paired

with the appropriate imaging. Ultimately, the fluid collections should be sampled and sent for microbiologic analysis to confirm the diagnosis and identify the infective organism.

Clinical Presentation

Patients with EN may have fevers, chills, dyspnea, and chest or back pain. As the EN continues to expand, subcutaneous swellings may appear, and the infection may even break through the skin, as in this case. Labs may show a leukocytosis and elevated inflammatory markers.

Imaging Findings

Chest radiography may demonstrate a loculated pleural effusion with increased density and fullness of the overlying chest wall soft tissue. The poor soft tissue contrast of radiography and its modest sensitivity for detection of small pleural effusions limits diagnostic accuracy, but CT of the chest will clearly demonstrate the pleural effusion. Cross-sectional imaging with intravenous contrast-enhanced CT is imperative to characterize the extent and qualitative features of pleural disease and guide surgical intervention when EN is identified.

The axial and coronal CT chest images in this case show a loculated, lenticular left pleural collection surrounded by inflamed parietal and visceral pleura, a finding known as the “split-pleura” sign. The split-pleura sign occurs when hyperemia from an infectious or inflammatory pleural process results in thickening of the normally nonvisible visceral and parietal pleura. Although a split-pleura sign is much easier to see with a contrast-enhanced study, it can also be identified on noncontrast studies. Early studies identified the split-pleura sign in up to 68% of all empyemas.

In addition to the split-pleura sign, this patient's CT shows fistulous communication between the pleural space and the chest wall via a draining sinus, which exits through an intercostal space into the left chest wall. This finding of a pleural effusion that directly communicates with an extrathoracic fluid collection is diagnostic for EN.

The presence of an air–fluid level in the chest wall collection suggests a bronchopleural fistula complicating the EN. This rare pulmonary complication occurs

when endobronchial gas escapes through an injured airway into the pleural space.

Differential Diagnosis

A split-pleura sign can also be seen in sterile reactive collections (parapneumonic effusion), malignant effusion, hemothorax, chronic tuberculous pleuritis, and after lobectomy or pleurodesis. In sterile reactive collections, pleural thickening is present, but less significant and with more homogeneous fluid density. Septation, a fibrin-mediated process, is also typically lacking in sterile collections. Malignant effusions are associated with pleural nodularity, whereas pleural thickening in hemothorax is more uniform. A postsurgical split-pleura sign presents in the appropriate clinical context with changes specific to the intervention performed. The presence of subcutaneous swelling on physical exam and soft tissue gas on imaging should also raise suspicion for necrotizing fasciitis in the acute setting. Rarely, intra-abdominal infection may undergo transdiaphragmatic spread and resemble pleural space infection on chest CT. In the appropriate clinical context, further imaging of the abdomen may be indicated to elucidate the source of infection.

Answers

1. What are three imaging findings in Figures 1 and 2 that indicate a complex pleural collection?

Chest radiography demonstrates chest wall involvement in addition to a pleural effusion. Axial and coronal CT images show pleural thickening and enhancement with the “split pleura sign,” extension of the pleural fluid collection into the chest wall, air in the pleural space, and fluid loculation.

2. What is the most likely diagnosis of this patient?

Empyema necessitans.

3. What is the most common cause of this entity?

Infection, specifically with *Mycobacterium tuberculosis*.

Follow-Up

The axillary pustule spontaneously drained 500 ml of purulent fluid before the patient went for surgical

washout of the subcutaneous spaces. A Penrose drain was placed in the affected chest skin and a chest tube was placed in the pleural space. Cultures grew vancomycin-resistant *Enterococcus faecium*. The preceding course of necrotizing

pneumonia and surgically created subcutaneous tracts with communication to the pleural space, in combination with the bronchopleural fistula, were risk factors for the development of EN. Antibiotics were narrowed to

linezolid, supplemental oxygen was weaned, and the chest tube was removed before discharge. ■

Author disclosures are available with the text of this article at www.atsjournals.org.

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