CLINICAL VIGNETTE

Community Acquired Pneumonia Complicated by Empyema

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Case

A 43-year-old male without significant medical or surgical history presented via telemedicine visit with mild body aches, night sweats, congestion and coughing for 1 week. One week prior to presentation he was climbing under his house and disturbed some rat feces. The same evening of the direct rat feces exposure he developed night sweats and felt he was functioning at "eighty percent of his normal capacity." He also reported fatigue, body aches, chest congestion, coughing and hot with cold flashes. The symptoms were initially mild but noticeable. The cough was dry and only occurred with deep breathing. He also developed diarrhea which had resolved prior to the visit. He was concerned about occupational exposure due to rat dropping contact and poor ventilation under his home. He felt that his symptoms aligned with toxoplasmosis. Two days later he was evaluated in urgent care with chest x-ray and lab work. His chest x-ray reported lingular consolidation suspicious for pneumonia. Laboratory tests noted a normal white blood cell count without shift. Sedimentation Rate, and C-Reactive Protein were elevated but procalcitonin was normal. COVID-19 PCR, Influenza A/B and RSV, Bartonella Henselae Ab IgG IgM, negative cocci, acute cytomegalovirus and Epstein-Barr virus (CMV/EBV), Toxoplasma IgA ELISA, Toxoplasma IgG and IgM were all negative.

The urgent care physician advised the patient his lungs were clear and recommended against antibiotics noting this was likely a viral syndrome.

Four days later, his symptoms had worsened with increased cough every couple hours with pleuritic pain in the sternum and back. He reported that he could no longer lie down due to the excessive coughing and could only take shallow breaths to prevent coughing. The patient requested an emergent in-person visit with a primary care physician. During the chest examination, on auscultation there was decreased air entry in his upper lobes with rhonchi in lower and upper lobes of both lungs. Patient completed a new chest x-ray which reported an interval mild increase in size and density of the previously noted left lingula opacity, concerning for pneumonia and a small left pleural effusion. A CT chest with contrast reported a focal opacity in the lingula concerning for infectious consolidation. He was empirically started on treatment for community acquired pneumonia with amoxicillin and azithromycin.

Patient contacted his physician via MyChart messaging application on day 6 of 10 of outpatient antibiotics reporting knife-like chest pain which felt like a heart attack and worsened with coughing. His legionella Pneumophila Ab,IgG titer was elevated at 1:256 (normal is <1:128) but negative legionella urine antigen. His white count had increased to 18.60x10E3/uL from a normal baseline. C-reactive protein increased to 14.5 mg/dL along with elevated procalcitonin. His chest x-ray also worsened with progressive opacification in the lingula and left lower lobe and interval development of a small-moderate left pleural effusion with evolving pneumonia. He was directed to the emergency department.

In the emergency department, the patient was hemodynamically stable on room air initially with a CURB65 score of 0. He was admitted for intravenous (IV) antibiotics and empirically started on IV levofloxacin 750 mg daily and nasal oxygen. Computed tomography (CT) noted an increased, multiloculated large left pleural effusion with thickening of the pleural surfaces concerning for empyema, mild shift of the mediastinum to the right was also present. Partial atelectasis of the left upper and lower lobes with heterogeneity of the lingula was seen. A bedside thoracentesis was performed consistent with fluid confirmed a complicated parapneumonic effusion. A bedside ultrasound guided chest tube placement was attempted, unsuccessfully, since there was no good window for bedside chest tube due to lung parenchyma floating in the window along the left lateral mid-axillary line. Interventional radiology subsequently placed a CT-guided chest tube. He was started on tPA/dornase twice a day for three consecutive days to help drain the infected effusion. He completed 5 days of levaquin and was transitioned to IV ceftriaxone and metronidazole.

A follow up CT chest five days later noted a small residual loculated left pleural collection. Infectious disease consultants recommended stopping ceftriaxone and metronidazole and switching to amoxicillin-clavulanate for a four-week course. A thoracic surgeon scheduled patient for flexible bronchoscopy, left video assisted thoracic surgery, and left decortication. After the procedure he was admitted to the intensive care unit with three chest tubes. Antibiotics were upgraded to parenteral piperacillin/tazobactam and linezolid. Over subsequent days, the chest tubes were removed and he was weaned to room air with normal saturation. He was transitioned back to oral

amoxicillin-clavulanate to complete a four-week course after discharge.

Discussion

Pleura abutting an area of pneumonic consolidation can fill with pleural fluid becoming a parapneumonic effusion. If parapneumonic effusions become infected they are labeled a complicated parapneumonic effusion or empyema. Parapneumonic effusions can be classified as uncomplicated, or simple effusions or complicated. Complicated parapneumonic effusions include: empyemas, complex effusions, and uniloculated effusions.

A complicated effusion results when a parapneumonic effusion becomes infected with bacteria. An empyema occurs when the complicated parapneumonic effusion is filled with pyogenic bacteria, mycobacteria, parasites or fungal infections. A complex effusion occurs when internal loculations develop within the effusion. A uniloculated effusion is a complicated effusion without internal septae.

Only two to three percent of pneumonias develop a parapneumonic effusion or empyema.[1] After the advent of antibiotics the incidence of parapneumonic effusions significantly decreased. However patients with pneumonia admitted to the hospital have a higher incidence of parapneumonic effusions.[2,3] Parapneumonic effusions can vary between those that are identified on CT scan or after aspiration. Parapneumonic effusion risk factors include: gastroesophageal reflux, aspiration risk, poor dental hygiene, alcohol or IV drug abuse, immunosuppression, and age over 65 years. Our patient had none of these risk factors.

Most parapneumonic effusions or empyema are classified into three categories: simple or uncomplicated, complicated or empyema, or chronic organized parapneumonic effusions. Pleural fluid in uncomplicated parapneumonic effusions have exudative appearance with protein rates greater than 0.5 of the serum value or lactate dehydrogenase (LDH) level more than 0.6 than in the serum LDH. In simple or uncomplicated effusions the pleural fluid will have normal glucose and pH levels with no bacteria. Stage 2 effusions have microorganisms identified within the pleural fluid. Pleural fluid analysis reveals high white cell count, pH <7.20, glucose <2.2 mmol/L (<40 mg/dL) and LDH >1000 IU/L. If pus is noted in the Stage 2 pleural fluid it is considered an empyema. Stage 3 is when the parapneumonic effusion appears to have chronic organization. The parapneumonic effusion develops a fibrinous pleural covering which traps the lung preventing full expansion. One week after CT guided chest tube placed to drain his complicated parapneumonic effusion, repeat CT chest showed evidence of a trapped lung,[4] and the patient underwent left video assisted thoracic surgery, pneumolysis, and left decortication.

The most common bacteria in a parapneumonic effusion or empyema are Streptococcus pneumoniae, oral streptococci, anaerobes, and Staphylococcus aureus. Our patient was assumed to have community acquired pneumonia which developed into a complicated parapneumonic infection within the pleural space by either Streptococcus pneumoniae, oral streptococci, anaerobes, or Staphylococcus aureus which is why amoxicillin-clavulanate was the appropriate broad-spectrum antibiotic. When an empyema is the result of aspiration pneumonia microaerophilic streptococci and anaerobes are usually the causative agent. Reactivation of latent tuberculosis can contribute to a Mycobacterial effusion. Fungal complicated parapneumonic effusions or empyemas are rare, often occurring in patients who are immunocompromised or as result of thoracic surgery.

Parapneumonic effusion or empyema are very similar to pneumonia on history and physical exam. Patients may present with new or unremitting fever, coughing with sputum production or chest pain. Our patient had completed six days of antibiotics for community acquired pneumonia but continued to have chest pain and malaise with no improvement. Risk factors for empyema include recurrent Gastroesophageal reflux disease (GERD), aspiration, or poor dental hygiene.[5] Findings on physical examination include dullness to percussion and decreased breath sounds. Labs reflect inflammation including elevated white blood cell count with elevated neutrophils, elevated erythrocyte sedimentation rate (ESR), and elevated c-reactive protein (CRP). Analysis of aspirated pleural fluid allows differentiation of a simple versus complicated parapneumonic effusion. Chest x-ray, ultrasonography and CT scan also assist in the diagnosis and management of simple or complicated parapneumonic effusions and empyemas.

The diagnostic testing for parapneumonic effusions is well described in published guidelines. Once the chest x-ray has identified the pleural effusion one should proceed with bedside ultrasound to determine if the pleural fluid is amenable to diagnostic aspiration. CT scan may be needed when there is concern for loculation or anatomical complex effusion. Our patient had diagnostic ultrasound guided thoracentesis performed at bedside but due to the lack of a clear window for the bedside chest tube a CT guided chest tube was placed. CT chest is a more sensitive diagnostic imaging modality than a chest x-ray or ultrasonography.[6] Chest CT can help identify stage 3, chronic organization of a complicated parapneumonic effusion as well.

The pleural fluid drained from a diagnostic ultrasound guided thoracentesis or CT guided thoracentesis should be sent for cell count with differential and for total protein, lactate dehydrogenase (LDH) and glucose. Microbiologic studies of pleural fluid should include aerobic, anaerobic, mycobacterial and fungal cultures with sensitivities[7] if thoracocentesis drains frank pus that establishes an empyema diagnosis. The pH of the pleural fluid may be helpful. Normal pH supports diagnosis of a simple or uncomplicated parapneumonic effusion while a pH of less than 7.2 supports a complicated, parapneumonic effusion or empyema.

The majority of uncomplicated parapneumonic effusions will improve with antibiotics and will not require any drainage.

Complicated parapneumonic effusion will require drainage and empyemas require a chest tube.

The RAPID score helps predict mortality from a pleural infection.[8] The scoring ranges from 0 to 7 points, based on renal status, patient age, presence of purulence, community acquired vs. hospital acquired infection, and lab findings, especially albumin level. Our patient had a RAPID score of 1 point indicating low risk; with 1.5% 3-month mortality.

Empiric antibiotic coverage is needed when parapneumonic effusion or empyema are suspected. Antibiotics should be initiated while awaiting pleural fluid analysis, unless there is a strong concern for mycobacteria or fungi. Empiric coverage should be based on whether the infection is community, hospital acquired, due to aspiration, or trauma. All systemic antibiotics enter pleural space except aminoglycosides.[9] For complicated community-acquired parapneumonic effusions or empyema, treatment should cover Streptococcus pneumoniae and oral pharynx anaerobes. These include third generation cephalosporin plus metronidazole or beta-lactam/beta lactamase inhibitor combination. After our patient underwent a VATS and decortication, his antibiotic coverage was changed from augmentin to zosyn plus metronidazole. If there is concern for methicillin-resistant *Staphylococcus aureus* (MRSA) or pseudomonas broadening of antibiotic coverage should be based on local antibiograms recommendations. When there is concern for hospital acquired parapneumonic effusions coverage should include pseudomonas and anaerobic bacterial coverage. The duration of antibiotic therapy will vary. In uncomplicated bacterial parapneumonic effusions therapy can be seven to fourteen days. While complicated parapneumonic effusions antibiotic duration should last 14 to 21 days. In patients like ours who had an empyema the antibiotic treatment duration is four to six weeks. Our patient was advised by infectious disease to complete a total four weeks of antibiotics.[9]

Drainage of complicated parapneumonic effusions or empyema requires chest tubes or thoracostomy drainage. Loculated effusions often may require and third chest tubes or thoracic surgical intervention.[10] For our patient the hope was use of intrapleural tissue plasminogen activator (tPA) with deoxyribonuclease (DNase) would decrease the need for surgery. Due to lung trapping seen on CT scan, and after a week of chest tube drainage, with tPA/DNase, and broad antibiotic coverage our patient underwent a Left VATS, Pneumolysis, and Left decortication.

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