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CHEST

A 28-Year-Old Man With Chest Pain, Shortness of Breath, and Hemoptysis After Recovery From Coronavirus Disease 2019 Pneumonia

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CASE PRESENTATION: A 28-year-old man presented with shortness of breath, chest pain, and scant hemoptysis. Three weeks previously, he was admitted for coronavirus disease 2019 pneumonia that had been diagnosed by nasal swab polymerase chain reaction. Chest CT imaging demonstrated bilateral ground-glass opacities without evidence of VTE. He was treated with hydroxychloroquine, up to 7 L/min oxygen, and self-proning. After 8 days of hospitalization, he was discharged on 4 L/min oxygen. After discharge, his symptoms and hypoxia resolved.

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Two weeks after initial hospitalization, he presented with new-onset chest pain due to a right-sided pneumothorax. After chest tube thoracostomy, the pneumothorax resolved, and the next day he was discharged on 1 L/min oxygen. Figure 1 shows patient's chest CT from initial hospitalization with coronavirus disease 2019 (COVID-19) pneumonia, and Figure 2 shows patient's chest radiographs from second hospitalization with pneumothorax.

On the morning of the current presentation, he had a coughing paroxysm followed by shortness of breath, chest pain, and hemoptysis (<25 mL). A chest radiograph demonstrated a recurrent right-sided pneumothorax that was treated with needle decompression and chest tube thoracostomy.

Prior to his hospitalization for COVID-19 pneumonia, the patient had no significant medical, surgical, or family history. He smoked a few cigarettes daily for 10 years but stopped immediately prior to his first hospitalization.

Physical Examination Findings

After chest tube insertion, his temperature was 37.2°C, heart rate was 100 beats/min, respiratory rate was 17 breaths/min, BP was 104/66 mm Hg, and oxygen saturation was 93% on 2 L/min oxygen. The physical examination was notable for bilateral crackles, most prominent on the right side.

Diagnostic Studies

WBC count was 14,500/mL with normal differential; hemoglobin level was 15.4 g/dL, and platelet count was 264,000/mL. A complete metabolic panel and liver function panel results were normal. Nasopharyngeal polymerase chain reaction testing for COVID-19 was now negative. HIV enzyme-linked immunosorbent assay result was negative. Sputum culture showed normal respiratory flora. Chest imaging from current hospitalization was significant for the findings shown in Figure 3.

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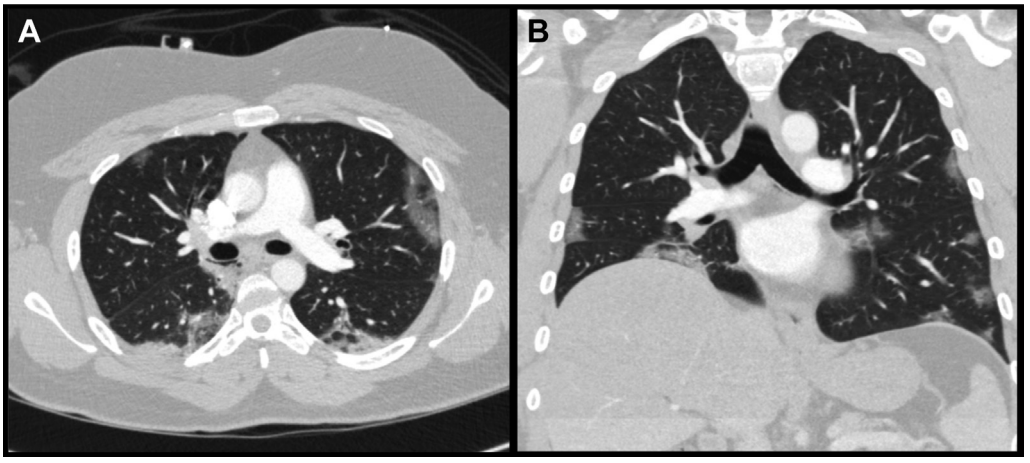

Figure 1 – *A, Axial and B, coronal images from chest CT angiograms that were obtained during the first hospitalization for coronavirus disease 2019 pneumonia show bilateral, peripheral patchy ground-glass opacities without evidence of VTE.*

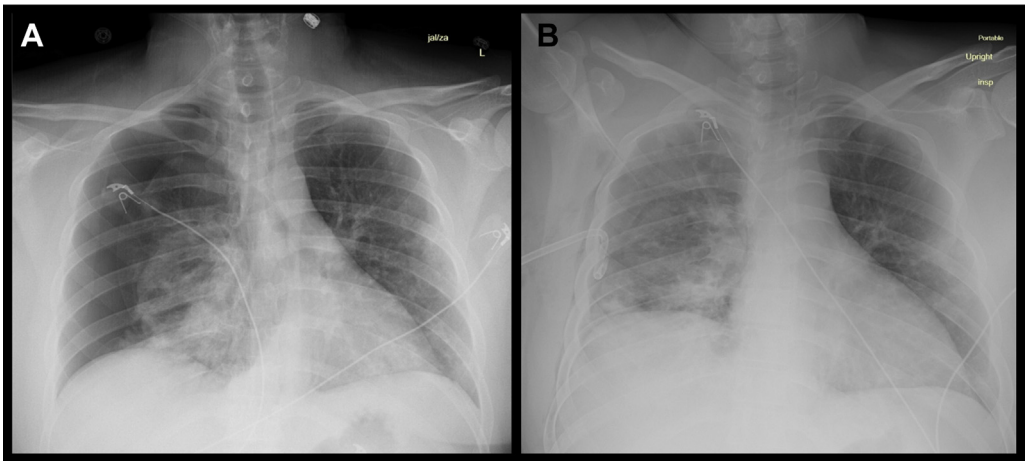

Figure 2 – *A, Chest radiograph that was obtained during second hospitalization shows a large right-sided pneumothorax. B, Chest radiograph that was obtained during the same hospitalization immediately after placement of chest thoracostomy tube shows resolution of the pneumothorax.*

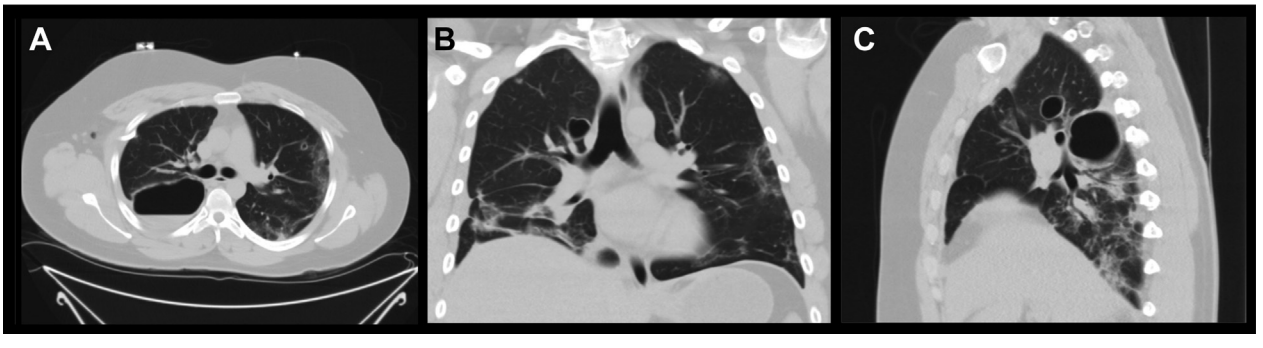

Figure 3 – *A-C: A, Axial, B, coronal, and C, sagittal images from chest CT imaging during the current admission after right-sided chest thoracostomy placement for recurrent pneumothorax. The images show improvement in previous bilateral ground-glass opacities and new abnormal air-filled spaces in both the right and left hemithorax.*

What is the diagnosis?

Diagnosis: Rupture of COVID-19-induced pneumatocele caused a pneumothorax and a loculated hydropneumothorax

Discussion

Pneumatoceles are lung cysts, which are defined as intraparenchymal air-filled spaces with distinct thin walls that occur after pneumonia or trauma. These cavities are formed when prior lung necrosis resolves into an air-filled cavity that subsequently is maintained by inflammatory cells within the feeding airway that act as a one-way valve. Pneumatoceles are differentiated from other types of lung cysts, such as incidental cysts, by their transient nature and association with known inciting events.

Cystic structures that meet the definition of pneumatoceles have been described during COVID-19 pneumonia, although their natural history is unknown. In non-COVID disease states, pneumatoceles typically resolve without intervention. However, pneumatoceles may become infected, expand and cause tension physiologic conditions, or rupture resulting in pneumothorax. These complex pneumatoceles can be treated successfully with catheter placement or surgical intervention. However, there are no widely accepted guidelines on to how to manage pneumothorax in this setting.

A *pneumothorax* is defined by air in the pleural space; a pneumothorax that occurs without an inciting event is known as a *spontaneous pneumothorax*. A spontaneous pneumothorax that occurs in patients with no known lung disease is called a *primary spontaneous pneumothorax* (PSP); a pneumothorax that occurs in the setting of an underlying lung disease is known as a *secondary spontaneous pneumothorax* (SSP). However, up to 60% of patients with presumed PSP have undiagnosed blebs and bullae that can be detected by chest CT imaging, which makes the distinction between PSP and SSP less clear. Causes of SSP are heterogenous, given the variety of predisposing illnesses that include emphysema, cystic lung disease, cystic fibrosis, lung malignancy, and necrotizing pneumonia. In the initial AIDS epidemic, pneumocystosis due to *Pneumocystis jirovecii* was a well-known cause of spontaneous pneumothorax, including spontaneous bilateral pneumothoraces.

Pneumothoraces can become loculated when air is trapped in a cavity between lung and chest wall due to adhesions. In the case of a loculated hydropneumothorax that occurs in a lung fissure, it can be difficult to differentiate from a pulmonary abscess or large pneumatocele. A combination of epidemiology, symptoms, laboratory data, and chest imaging may aid in this process. Most pulmonary abscesses are caused by aspiration and involve polymicrobial infections that include anaerobic bacteria. Unlike pneumatoceles, which are typically asymptomatic and resolve without intervention, pulmonary abscesses present with fever, cough, and/or chest pain. A hydropneumothorax is caused by a variety of processes that include necrotizing pneumonia and thoracic procedures with variable symptoms that reflect both the size of the hydropneumothorax and state of the underlying condition. A loculated hydropneumothorax in a fissure is likely to be elliptical on coronal imaging, to have a smooth inner surface, and to displace airways. In contrast, a pneumatocele is commonly spherical on coronal imaging, and a pulmonary abscess typically has thick walls with airways that lead into or through the cavity, potentially creating air bronchograms.

Current guidelines by the British Thoracic Society indicate that PSP can be managed in the outpatient setting with

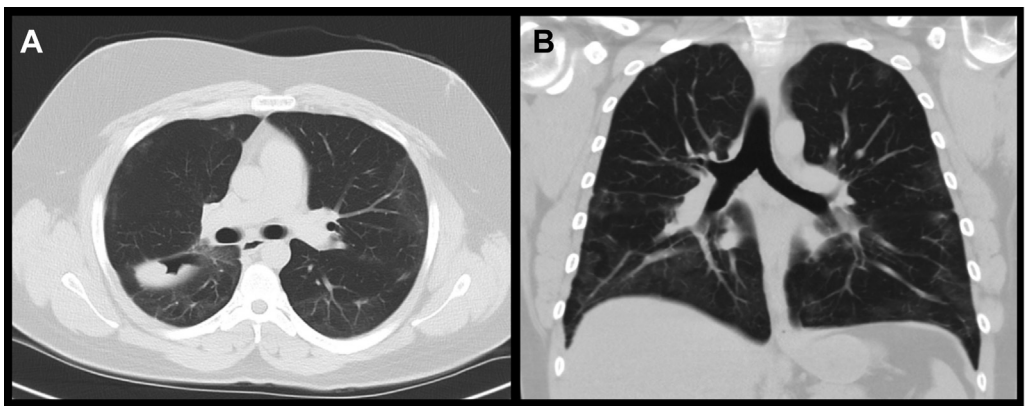

Figure 4 – *A, Axial and B, coronal images from chest CT imaging that were obtained at 1-month follow up. These images show complete resolution of previous pneumatoceles and marked reduction in the size of the loculated hydropneumothorax.*

observation if the pneumothorax is small and asymptomatic but recommend admission for supplemental oxygen and needle decompression if the pneumothorax is large or if the patient is symptomatic. Chest tube placement is reserved for patients in whom needle decompression fails. Surgical intervention with pleurodesis should be considered in patients with recurrent pneumothorax or persistent air leak after chest tube placement. Guidelines do not recommend obtaining a chest CT image in cases of PSP. However, there is considerable debate around this topic because chest CT imaging might identify patients with PSP who would benefit from surgical management to prevent recurrent pneumothorax.

For SSP, the British Thoracic Society recommends a more aggressive treatment approach. All patients with SSP should be admitted, regardless of intervention strategy. Additionally, most patients with symptomatic pneumothorax should be treated with chest tube placement and consideration of surgical intervention, such as video-assisted thoracoscopic surgery with pleurodesis. These guidelines are based largely on epidemiologic data that suggests that SSP is less likely to resolve and more likely to recur than PSP. Management of a hydropneumothorax is guided currently by expert opinion and case reports. Although the British Thoracic Society guidelines suggest that most patients will require chest tube drainage, the final management approach should be based on both the clinical status of the patient and the diagnostic testing that is required to identify and treat the cause of the patient's hydropneumothorax.

Clinical Course

After chest tube placement for his recurrent pneumothorax, the patient's symptoms of chest pain, shortness of breath, and scant hemoptysis improved. His sputum stains and cultures were negative for bacteria, mycobacteria, and fungi. Blood cultures were negative. Based on the lack of infectious symptoms and chest CT findings of a thin-walled elliptical fluid-filled air cavity at the site of the major fissure, the large air-fluid filled structure was deemed a loculated hydropneumothorax rather than a large pneumatocele or lung abscess. On day 5, there was no longer an air leak from the chest tube, and it was successfully removed. Surgical referral for pleurodesis was deferred as the pneumatoceles had diminished in size. At 1-month follow up, the patient's symptoms had largely resolved. Repeat chest CT images demonstrated resolution of prior pneumatoceles and a significant decrease in the size of the loculated hydropneumothorax (Fig 4).

Clinical Pearls

1. *Lung cysts are defined as intraparenchymal air-filled spaces with sharply demarcated thin walls. The differential diagnosis of lung cysts is wide and includes congenital, infectious, and malignant causes and various interstitial lung diseases.*
2. *Pneumatoceles are defined as lung cysts that most commonly develop after trauma or pneumonia. Pneumatoceles have been sporadically observed in patients with COVID-19 pneumonia.*
3. *Secondary spontaneous pneumothorax may occur after COVID-19 pneumonia, even in the absence of invasive or noninvasive positive pressure ventilation, likely due to rupture of subpleural pneumatoceles.*
4. *A loculated hydropneumothorax in a lung fissure can be difficult to differentiate from a large pneumatocele or lung abscess. On chest CT imaging, a loculated hydropneumothorax in a fissure is commonly elliptical on coronal imaging; a pneumatocele is often spherical, and a pulmonary abscess typically has thicker walls.*

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Suggested Readings

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