CHEST

Cavitary Lung Diseases
A Clinical-Radiologic Algorithmic Approach

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Cavities occasionally are encountered on thoracic images. Their differential diagnosis is large and includes, among others, various infections, autoimmune conditions, and primary and metastatic malignancies. We offer an algorithmic approach to their evaluation by initially excluding mimics of cavities and then broadly classifying them according to the duration of clinical symptoms and radiographic abnormalities. An acute or subacute process (< 12 weeks) suggests common bacterial and uncommon nocardial and fungal causes of pulmonary abscesses, necrotizing pneumonias, and septic emboli. A chronic process (≥ 12 weeks) suggests mycobacterial, fungal, viral, or parasitic infections; malignancy (primary lung cancer or metastases); or autoimmune disorders (rheumatoid arthritis and granulomatosis with polyangiitis). Although a number of radiographic features can suggest a diagnosis, their lack of specificity requires that imaging findings be combined with the clinical context to make a confident diagnosis.

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To date, there are few specific guidelines published on the optimal approach to cavitary lung disease.[1,2] The intention of this review is to highlight the specific clinical, laboratory, and radiographic features that can help guide clinicians in their approach. For purposes of this report, radiographic findings refer to abnormal chest imaging features seen on CT scans of the chest.

A cavity, as defined by the Fleischner Society, is a gas-filled space, seen as a lucency or low-attenuation area, within a nodule, mass, or area of parenchymal consolidation.[3] It has a clearly defined wall > 4 mm thick.[2] Although any strict definition would be arbitrary, we suggest that acute and subacute cavities are those < 12 weeks old (according to prior imaging or duration of symptoms),

ABBREVIATIONS: CNA = chronic necrotizing aspergillosis; GPA = granulomatosis with polyangiitis; ILD = interstitial lung disease; IPA = invasive pulmonary aspergillosis; MAC = *Mycobacterium avium* complex; NTM = nontuberculous mycobacteria; RA = rheumatoid arthritis

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and chronic cavities are ≥ 12 weeks old. We derived the definition of "chronic" from the US National Center for Health Statistics, which defines a chronic condition as one lasting 12 weeks (3 months) or longer.[4] Before we delve deeper into a discussion about cavitary lung disease, it is important to discuss conditions that mimic cavities. These include cysts, emphysema, infected bullae, and cystic bronchiectasis.

It is also helpful to recognize the chest imaging findings that can guide clinicians to a particular diagnosis. For example, multiple peripheral nodules in varying stages of cavitation (Fig 1) indicate septic emboli, pulmonary Langerhans cell histiocytosis, or possible infarction. Bronchiectasis and accompanying peripheral small airways disease (Fig 2) typically indicate widespread chronic infection. Halo (Fig 3) and reversed halo (Fig 4) signs often are seen in association with various rheumatologic diseases, infections (including fungal), septic emboli, pulmonary infarcts, and malignancies, especially metastatic disease with hemorrhage such as choriocarcinoma. An irregular internal wall (Fig 5) is seen more frequently in malignant cavitary lesions. Linear outer border, associated bronchial wall thickening, satellite nodules, consolidation, and ground-glass opacities are associated more commonly with benign cavitary lesions.

Algorithmic Approach

In our algorithmic approach (Fig 6), we begin with ensuring that the lesions visible on CT scans are cavitary lesions. It is important to distinguish these lesions from mimics of cavitary lesions. We emphasize accompanying radiographic features that may point toward specific causes. In addition, we discuss how acuity or chronicity of cavitation, clinical features, and other laboratory indexes influence the likelihood of diagnosis. Comparison with prior imaging, when available, is helpful in gauging the tempo of the disease process—a rapidly evolving cavity (< 12 weeks) strongly suggests an acute infectious cause. In contrast, cavities with a more chronic or indolent evolution (≥ 12 weeks) suggest chronic infections, autoimmune conditions, or malignancy. However, there may be significant overlap in temporal evolution of cavitary disease processes, depending in part on the patient's immune status and comorbidities.

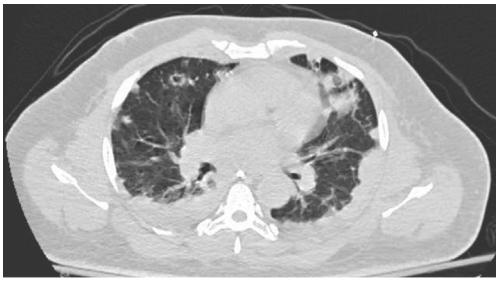

Figure 1 – *Axial CT scan obtained in a 55-year-old man with a skin abscess leading to methicillin-resistant* Staphylococcus aureus *bacteremia and septic emboli. There are multiple nodules in varying stages of cavitation.*

Step 1: Are We Dealing With True Cavities?

True cavities must be differentiated from their mimics, such as cystic disease, emphysema, infected bullae, and cystic bronchiectasis. The definitions and radiographic appearances of these mimics that distinguish them from cavities are summarized in Table 1.[5-8]

Step 2: Assess Disease Duration

Use the patient's history and previous chest images to estimate disease duration. If the estimated disease duration suggests an acute or subacute process (< 12 weeks), see step 3. If it is more than 12 weeks, see step 4.

Step 3: Acute and Subacute Cavities (< 12 Weeks in Duration)

Although the differential diagnosis of an acute or subacute cavity is wide, the first step is to rule out recent infection. Clinical features suggesting infection include fever, chills, and cough.[9] Laboratory values that suggest an acute bacterial infection include sputum cultures demonstrating respiratory pathogens, elevated white blood cell count with shift to the left, and elevated procalcitonin C levels. For fungal infections, blood cultures, β-D-glucan level, galactomannan level, as well as measurements of specific fungal antigens in the blood and urine, may be important. Cavitary *Mycobacterium tuberculosis* can manifest acutely; however, it is more likely to have a chronic manifestation and is discussed later. Common infectious causes, including bacterial lung abscesses, necrotizing pneumonias, septic emboli, and acute fungal infections, are described here and summarized in Table 2.

Bacterial Pathogens: Lung abscesses are pus-containing necrotic lesions of the lung parenchyma that show an air-fluid level at chest imaging. Microbial cultures performed from lung abscesses usually demonstrate multiple pathogens.[10-12] These include microaerophilic streptococci and viridans streptococci, which were considered the most common.[13] However, studies from Japan and Taiwan have implicated both