Cavitary lung diseases

Poster No.: C-1885
Congress: ECR 2014
Type: Educational Exhibit
Authors: M. Ben Lassoued¹, A. DAADOUCHA², M. Hachicha², E. Kaddour², K. Chermi¹, R. ALOUNI²; ¹SFAX/TN, ²Kairouan/TN
Keywords: Cavitation, Diagnostic procedure, CT, Respiratory system
DOI: 10.1594/ecr2014/C-1885

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file. As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method ist strictly prohibited. You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages. Please note: Links to movies, ppt slideshows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Learning objectives

The goal is to provide the clinician and the radiologist with an overview of the diseases most commonly associated with lung cavities
Background

Definition

**Pulmonary cavities** are gas-filled areas of the lung in the center of a nodule, mass or area of consolidation and may be clinically observed by use of plain chest radiography or computed tomography.

Traditionally, the term "cyst" is used to describe an air-containing space surrounded by a relatively thin wall (less than 4 mm), and the term "cavity" is used to describe an air-containing space within a pulmonary consolidation with a relatively thick wall (more than 4 mm) or within a surrounding infiltrate or mass identified upon radiological examination.

They may be filled with air as well as fluid and may also demonstrate air-fluid levels.

**Physiopathology of cavities**

A cavity is the result of any of a number of pathological processes including suppurative necrosis (e.g., pyogenic lung abscess), caseous necrosis (e.g., tuberculosis), ischemic necrosis (e.g., pulmonary infarction), or displacement of lung tissue by cystic structures (e.g., Echinococcus). In addition, malignant processes may cavitate because of treatment-related necrosis, internal cyst formation, or internal desquamation of tumor cells with subsequent liquefaction. The likelihood that a given process will cavitate depends upon both host factors and the nature of the underlying pathogenic process. The prevalence of cavities among persons with a given process varies widely. In general, certain processes tend to form cavities more commonly than others.
Findings and procedure details

Common Etiologies

Radiological and clinical parameters may provide helpful clues in the diagnostic evaluation of a patient with cavitary lung disease, especially when the disease is focal.

The measured thickness of the cavity wall, the character of its inner lining (irregular or smooth), the nature of its contents, and location. Woodring et al studied the diagnostic implications of cavity wall thickness in 65 cases of solitary cavities of the lung and found that all lesions in which the thickest part of the cavity wall was 1 mm were benign; of cavities in which the greatest wall thickness was 4 mm or less, 92% were benign; lesions 5 to 15 mm were equally divided between benignity and malignancy; and when the cavity wall was greater than 15 mm in thickness, 95% of lesions were malignant.

Inner contour of the cavity is usually nodular or irregular in cancer, shaggy in acute lung abscess, and smooth in other cavitary lesions.

Some cavitary lesions may be filled with fluid or solid contents. For example, a bronchogenic cyst may be filled with fluid and appear as a mass lesion on chest radiography. The presence of an air-fluid level does not correlate well with benignity or malignancy. Solid contents within a cavity may be seen in infectious processes, such as invasive aspergillosis, and in necrotic cancer.

The location of focal lesions may be of help in limiting the differential diagnosis, eg, propensity of tuberculosis to affect the upper lobes of the lung.

Computed tomography can show the size, shape, and precise position of cavities when these details are not apparent on chest radiography.

Two clinically important parameters in evaluating cavitary lesions are the tempo of the disease process and the clinical context. The diagnostic possibilities are strongly influenced by knowing whether a radiological lesion is acute or subacute vs chronic (>1 month in duration). This distinction is usually based on the duration and course of related symptoms and signs as well as comparison to previous imaging studies, when available. Acute and subacute processes that evolve over a relatively short period (days to a few weeks) generally suggest infectious or other progressive inflammatory disorders as well as disorders of cardiovascular (embolic) or traumatic causes. Chronic processes are more likely due to neoplastic diseases, long-standing inflammatory or fibrotic disorders, and congenital lesions. The clinical context is crucial and includes age, sex, smoking history, immunocompetency, underlying diseases, drug or other treatments, associated extrapulmonary symptoms and signs, environmental and occupational exposure, recent trauma, travel history, and relevant laboratory test results.
1/ Malignancies

Malignancy is commonly the first diagnosis to consider for a cavitary lesion, particularly in a middle-aged or older adult with a history of cigarette smoking.

Primary lung cancer is a common disease. Other primary tumors in the lung, such as lymphoma and Kaposi’s sarcoma, may also present with cavitary lesions, particularly among persons infected with human immunodeficiency virus.

The presence of cavitation in a lung tumor has been associated with a worse prognosis.

Typically, the cavity will have thick wall, nodular extensions of tumor (mural nodules) projecting into the lumen of cavity are frequent. Occasionally, a cavitated lung cancer will have smooth, thin walls. Rarely, a meniscus or air crescent sign may be seen in association with a cavitated bronchogenic carcinoma. (Fig.1)

Metastatic disease from other primary sites may also cavitate, but this occurs less frequently than in primary lung cancers: an estimated 4% of metastatic tumors have been noted to cavitate. Interestingly, metastatic tumors of squamous cell origin are also more likely to cavitate than tumors of other origins, suggesting a common pathogenesis for cavitation among these tumors. (Fig.2)

Cavitating lung metastases have been reported with primary lung, head and neck, thyroid, breast, bone, kidney, pancreas, colon and rectum, urinary bladder, penis, testis, uterine, cervix and skin carcinomas. Chemotherapy is known to induce cavitation.

2/ Mycobacterial infection

Tuberculosis is the predominant infectious cause of cavitary pulmonary lesions in Tunisia, which predominantly occurs in patients less than 50 years of age. Large cavities in the upper lobe are significantly associated with mycobacterial infection, but the location is of limited help in the differential diagnosis of most cavitary lesions. (Fig.3)

Multiple cavities are often present and frequently occur in areas of consolidation. Cavities can vary widely in size and have been reported to have both thick and thin walls. The presence of cavitation is associated with a greater degree of infectiousness, likely due to higher organism burden.

3/ Pulmonary abscess
A lung abscess is a cavity that contains purulent material resulting from a pulmonary infection. Gram negative, anaerobic bacteria and occasionally streptococcus pneumonia are responsible for its development.

The characteristic appearance of a lung abscess on CT is thick walled cavity that contains mobile, central fluid occurring in the middle of an area of consolidated lung. An air dilled level is often apparent on CT, even when it is not evident on the chest radiograph. (Fig.4)

4/ Pulmonary hydatid cyst

The localization of hydatid cyst in humans is mostly hepatic, with the lungs being the second most frequent location in adult.

Radiographically, the cysts are commonly seen as spherical, homogenous masses with smooth borders surrounded by normal lung tissue. An intact cyst is filled with clear fluid. Cysts may rupture spontaneously or due to trauma. As the cyst enlarges and erodes into the bronchioles, air enters the potential space between pericyst and endocyst and appears as a thin lucent crescent "meniscus sign". When hydatid cyst completely collapsed, the crumpled endocyst floats freely in the cyst fluid "water lily sign" (Fig.5)

5/ Aspergillosis

Aspergillus species are environmental molds that cause a wide range of pulmonary disease in humans. Pulmonary disease is most commonly caused by Aspergillus fumigatus

An aspergilloma, also referred to as a mycetoma or fungus ball, represents growth of aspergillus (usually A. fumigatus) within a preexisting lung cavity.

In areas where tuberculosis is endemic, tuberculosis is still the most common condition predisposing subjects to aspergilloma formation. However, any illness that causes a chronic, nonresolving pulmonary cavity produces an environment conducive to aspergilloma formation, and aspergillomas have been reported in association with most of the disease entities discussed in the present review.

Radiographically, an aspergilloma appears as a rounded opacity within a previously existing cavity; computed tomography can more accurately delineate the mass and surrounding air crescent than plain radiography.

Differentiating aspergilloma from malignancy is a significant issue, as there is considerable overlap in the appearances of the two conditions. Enhancement of the mass on computed tomography suggests malignancy, while adjacent bronchiectasis and a dependent location are more typical of aspergilloma. Other aspergilloma manifestations
include thickening of the cavity wall, a new air-fluid level within the cavity, or complete opacification of a previously air-filled cavity. (Fig.6)

**Invasive pulmonary aspergillosis** afflicts primarily severely immunocompromised patients, especially those with hematological malignancies, bone marrow transplant recipients, and those with long-term immunosuppressive or corticosteroid use.

Plain radiographs usually demonstrate consolidation or nodules with no evidence of cavitation.

Computed tomography scanning is more useful for early diagnosis than plain radiography. Specifically, the presence of a "halo sign," defined as a nodule surrounded by a zone of ground-glass attenuation, is reasonably sensitive (70 to 80%) and specific (60 to 98%) for invasive aspergillosis in high-risk patients. Cavitation generally occurs later in the course of the disease (1 to 2 weeks after the appearance of the halo sign) and is often noted during recovery from neutropenia in previously neutropenic patients. The onset of cavitation is heralded by the so-called "air crescent sign," defined as crescents of air surrounding nodular lesions; further necrosis due to fungal angioinvasion and resultant ischemia results in progressive cavity formation in up to 63% of patients.

**6/ Septic pulmonary emboli**

Septic emboli occur in patients with congenital heart diseases, endocarditis, infected intravascular prosthetic material ...

It typically appears as nodules located in the lung periphery, although wedge-shaped peripheral lesions and infiltrates are also seen.

The presence of a "feeding vessel" sign, in which a distinct vessel is seen leading to the center of a pulmonary nodule, suggests the diagnosis of septic embolus, but the specificity of this finding has been called into question.

**7/ Wegener's granulomatosis**

Wegener's granulomatosis (WG) is an idiopathic disease characterized by a granulomatous and necrotizing vasculitis. The CT lesions of pulmonary WG include nodules, masses, pulmonary consolidations and ground glass opacities. Nodules are the most frequent parenchymal abnormality. In untreated disease, nodules tend to increase both in size and number and may cavitate. The cavitary nodules may occasionally become infected to give an air filled level. (Fig.7)
Images for this section:

**Fig. 1:** Squamous cell carcinoma of bronchus showing cavitation. The CT scan shows that cavity wall is of variable thickness and the presence of mural nodule

© Tunisia
**Fig. 2:** Pulmonary metastases from breast neoplasm. Axial CT shows cavitating multiple metastases

© Tunisia

**Fig. 3:** Cavitary lung disease due to *Mycobacterium tuberculosis* visualized by computed tomography. Note the typical upper lobe predominance and extensive fibronodular infiltrates.

© Tunisia
**Fig. 4:** Patient with leukemia presenting with fever and chills. Axial CT of the thorax show a well-defined cavity with fluid and air contents suggestive of a lung abscess. Bronchial lavage cultures were positive for *Klebsiella*.

© Tunisia
Fig. 5: Hydatid cyst The CT images show the water lily sign created by collapsed and crumpled endocysts floating freely in the most dependent part of the cyst

© Service de Radiologie 20 Août. CHU Ibn Rochd. Casablanca. Maroc
Fig. 6: Aspergilloma visualized by computed tomography in a young man. The etiology of the underlying cavity was tuberculosis in this case.

© Tunisia
Fig. 7: Wegner granulomatosis in a 45 year old female. The CT shows cavitating masses with consolidation

© Tunisia
Conclusion

In summary, we have reviewed the most common etiologies of pathologic entities showing cavitary pulmonary lesions in patients.

Identification of pathologic findings that correlate with radiologic findings, clinical progression, and location is important in the evaluation of cavitary lung lesions in order to avoid unnecessary procedure or delayed treatment.
References


