Pulmonary Aspergillosis: Imaging Findings on HRCT

Poster No.: C-2504
Congress: ECR 2015
Type: Educational Exhibit
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Keywords: Infection, Cavitation, Image compression, Education, CT-High Resolution, Respiratory system, Lung, Thorax, Transplantation

DOI: 10.1594/ecr2015/C-2504

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Learning objectives

• Explain the pathophysiology and clinical manifestations of pulmonary Aspergillosis.

• Describe the radiographic findings on HRCT of the different forms of presentation of pulmonary Aspergillosis.

• Review the differential diagnosis with other entities that show similar findings.
Background

Epidemiology:

Pulmonary Aspergillosis is a fungal infection caused by species of *Aspergillus*, most commonly *A. Fumigatus*, a normal human sputum saprophyte. The majority of cases occur in people with underlying illnesses such as tuberculosis or chronic obstructive pulmonary disease (COPD), but with otherwise healthy immune systems. By the other hand people with deficient immune systems are at risk of more disseminated disease.

There are three main types of presentation:

Invasive aspergillosis: occurs almost exclusively in immunocompromised patients with severe neutropenia in which the immune system fails to prevent Aspergillus spores from entering the bloodstream via the lungs progressing over days to weeks. There has been a substantial augmentation in the number of patients at risk for developing invasive aspergillosis. These reasons include the growth in the number of transplant recipients, the development of new intensive chemotherapy treatments and the increased use of immunosuppressives. Histologic analyses are characterized by the invasion and occlusion of small to medium-sized pulmonary arteries by fungal hyphae, which lead to the formation of necrotic hemorrhagic nodules or pleura-based, wedge-shaped hemorrhagic infarcts. The clinical diagnosis is difficult, and the mortality rate is high.

Semi-invasive: also known as chronic necrotizing aspergillosis. It progresses over weeks to years. Risk factors for its development include chronic debilitating illness, diabetes mellitus, malnutrition, alcoholism, advanced age, prolonged corticosteroid therapy and COPD. Histologic analyses are characterized by the presence of tissue necrosis and granulomatous inflammation, similar to that seen in reactivation tuberculosis. Clinical symptoms are often insidious and include chronic cough, sputum production, fever and constitutional symptoms. In patients with COPD semi-invasive aspergillosis may manifest with a variety of nonspecific clinical symptoms such as cough, sputum production, fever lasting more than 6 months, reason by witch it is required a high clinical suspicion. Prognosis is often good, but some report up to 40% mortality.

Non-invasive: Aspergillus infection without tissue invasion. It typically leads to the conglomeration of intertwined fungal hyphae mixed with mucus and cellular debris (aspergilloma) within a preexistent pulmonary cavity or ectatic bronchus. The most common underlying causes are tuberculosis and sarcoidosis. The commonest clinical manifestation of saprophytic aspergillosis is hemoptysis (reports of up to 40%) witch may
be life threatening. Many patients are asymptomatic and may remain stable for years. Prognosis is generally good and approximately 10% resolve spontaneously.

**Diagnosis:**

Thorax CT is the imaging study of choice since it can assess lung abnormalities and features of angioinvasive fungal disease. If an aspergilloma is suspected consider the possibility of performing a supine and prone CT, which may demonstrate its intracavitary mobility.

Sputum culture, bronchoalveolar lavage, transthoracic biopsy and open lung biopsy.

Serum *Aspergillus* precipitin test.

Elevated serum galactomannan levels.

*Aspergillus* cell wall component.

**Treatment:**

Depends on type of presentation

*Invasive & semi-invasive aspergillosis:* Voriconazole is treatment of choice Amphotericin B, posaconazole, caspofungin also are effective.

*Non-invasive:* Oral itraconazole & intracavitary amphotericin B have shown mixed success.

Hemoptysis may require bronchial artery embolization or surgical resection.

**Main Differential Diagnoses:**

Other infection: Fungal, mycobacterial, bacterial.

Pulmonary emboli.

Wegener granulomatosis.
Findings and procedure details

We reviewed microbiologically confirmed pulmonary aspergillosis affected patients diagnosed in our hospital from July 2009 to July 2014.

Invasive: characterized by rapidly progressing nodules surrounded by a halo of ground-glass attenuation ("halo sign") or pleura-based, wedge-shaped areas of consolidation (hemorrhagic infarcts). In severely neutropenic patients, the halo sign is highly suggestive of angioinvasive aspergillosis. Similar appearances have been described in Wegener granulomatosis, Kaposi sarcoma, hemorrhagic metastases and atypical infections. Pulmonary sequestrations results in air crescents, similar to those seen in aspergillomas. The air crescent sign indicates recovery of white blood cell function and is associated with favorable outcome.

Semi-invasive: characterized by unilateral or bilateral segmental areas of consolidation (with or without cavitation) or adjacent pleural thickening and multiple nodular areas of increased opacity. These findings progress slowly over months or years. May show coexistent aspergilloma and is frequently associated with preexisting lung disease.

Aspergilloma: characterized by the presence of a gravity dependent round or oval solid mass surrounded by gas within a lung cavity (air crescent sign). Differential diagnoses of Aspergillomas include angioinvasive aspergillosis, echinococcal cyst, aneurysm in a tuberculous cavity and lung abscess. Aspergilloma are often associated with thickening of the cavity wall and adjacent pleura finding that may be the earliest sign. This thickening may resolve which suggests that it is due to a hypersensitivity reaction.
Images for this section:

**Fig. 1:** HRCT. Invasive Aspergillosis. Consolidation (red arrow), centrilobular nodules, groundglass opacity (yellow arrow).

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Fig. 2: HRCT. Seminvasive Aspergillosis. Consolidation of the anterior segment of the right upper lobe (red arrow). Centrilobular nodules.

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Fig. 3: HRCT. Aspergilloma (red arrow).

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**Fig. 4:** Coronal HRCT. Aspergilloma (red arrow).

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Fig. 5: HRCT. Invasive Aspergillosis. Consolidation, centrilobular nodules, groundglass opacity.

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Fig. 6: HRCT. Semilnvasive Aspergillosis. Unilateral (left) segmental area of consolidation with cavitation and adjacent pleural thickening and multiple nodular areas of increased opacity (centrilobular nodules).

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Conclusion

- It has recently been reported an increase of pulmonary aspergillosis not only in patients severely immunocompromised but also on those with mild immunodeficiency. Given its potential gravity, it is of the utmost importance a prompt diagnosis. Given the appropriate clinical setting, CT plays a mayor role not only in the identification of the disease but it also may suggest a specific diagnosis.
References


DOI: 10.1594/seram2014/S-0861.