Role of imaging in the evaluation of aspergillosis

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Authors: S. Elena Floriana, C. Moldoveanu, D. Negru, L. Moisii, A.-M. Alecsa-Lupu; Iasi/RO
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Learning objectives

- To report and illustrate the contribution of computed tomography (CT) in characterizing these cavitary pulmonary lesions

- To highlight the radiological findings that may help diagnosticate aspergillosis

- To discuss the role of imaging in the evaluation of aspergillosis

- To review the Rx and CT imaging findings of some common and not so common aspects of aspergillosis

- To demonstrate the role of cross sectional imaging in the diagnosis and management of sequelae and complications of pulmonary tuberculosis

- To know and identify the radiological features of these lesions.

- To properly manage these patients.

Background

Pulmonary aspergillosis is a collective term used to refer to a number of conditions caused by infection with a fungus of the Aspergillus species (usually Aspergillus fumigatus).

Although most people are often exposed to Aspergillus, infections caused by the fungus rarely occur in people who have a healthy immune system (may develop in an area of past lung disease or lung scarring such as tuberculosis or lung abscess). Aspergillus fumigatus is the usual species responsible for lung infections in immunocompromised patient.

Aspergilloma (mycetoma) is a fungus ball that occurs in cystic or cavitary disease and is unrelated to lung transplant. Cavitary disease may be secondary to fibrotic lung disease, e.g. previous tuberculosis, sarcoidosis, or ankylosing spondylitis.

**Symptoms:** cough, hemoptysis, fever, malaise, wheezing, weight loss, bone pain, chest pain, chills, decreased urine output, headaches, skin lesions, vision problems.

Aspergilloma is a benign source of bronchial bleeding.
Findings and procedure details

The pattern of abnormality depends on the patient's immune status: to an immunosuppression patient the typical appearance is that of invasive aspergillosis (poorly-margnated area or areas of homogeneous opacity that may resemble ordinary bacterial pneumonia in look and distribution, but more round and distant from the subpleural lung than is the case in common community infections), at patients with treatment immune status improves (cavitation within the masses with the formation of an air crescent).

A cavity with a mass within it, the air within the cavity forming a peripheral halo or crescent of air between an intracavitary mass and the cavity wall, giving rise to the 'air crescent' or 'air meniscus sign'. The term 'CT halo sign' refers to ground-glass attenuation surrounding (frequently incompletely) a nodule on CT. The ground-glass portion is an area of hemorrhage and the central area is necrotic lung. Apart from malignant neoplasms and hemorrhage following biopsy, the most common cause of a CT halo sign is invasive aspergillosis.

The cavity wall is generally of moderate thickness. The air crescent is created by the contained necrotic debris within the cavity.

This findings are localizate in the upper lobes and it can be associated with consolidation, ground-glass, nodules, tree in bud.

Aspergillus primarily affects the lungs, causing **4 main syndromes**: aspergilloma (the most common form seen radiographically), allergic bronchopulmonary aspergillosis, chronic necrotizing Aspergillus pneumonia and invasive aspergillosis.

**Invasive aspergillosis** occurs when there is an extension of aspergillus into viable tissue. Invasive pulmonary aspergillosis may present with single or multiple nodular infiltrates, which often progress to wedge-shaped areas of consolidation. Classical radiographic features include either solitary or multiple nodules or masses, with or without cavitation. Cavitation (the "crescent sign") is common later in the course of the infiltrate. In the appropriate clinical setting, CT may aid in the diagnosis of IPA by demonstrating the so called halo sign.

**Angioinvasive pulmonary aspergillosis**, together with the acute **aspergillus bronchopneumonia**, is the most common form of disease and is usually multifocal and nodular in appearance, with a rim of haemorrhage and/or consolidated lung is frequently found surrounding the nodule. They are fungal pneumonias seen almost exclusively in immunocompromised patients. Either disease may produce a homogeneous opacity, sometimes peripheral and wedgeshaped, sometimes segmental or lobar. Finally, viral
and protozoal organisms can cause a segmental homogeneous opacity that imulates bacterial infections.

**Allergic bronchopulmonary aspergillosis (ABPA)** is a hypersensitivity response to Aspergillus antigens in the lung and it occurs almost exclusively in asthmatic patients. Aspergillus spores germinate and proliferate in the proximal airways, which often show evidence of asthma-associated mucosal injury. The fungal hyphae increase mucus production and bronchial injury, which can result in bronchiectasis. Also distal bronchioles may be distended with mucus and their walls may show inflammatory changes. A bilateral upper lobe distribution is most commonly seen in patients with cystic fibrosis and allergic bronchopulmonary aspergillosis.

Chest radiography may vary from fleeting pulmonary infiltrates to mucoid impaction to central bronchiectasis, may show a mass in a preexisting cavity, usually in an upper lobe manifested by a crescent of air partially outlining a solid mass, solitary or multiple nodules. The 'halo sign' was thought to be pathognomonic of invasive aspergillosis.

CT scanning is helpful for better defining bronchiectasis and images may show that apparent lobulated masses are mucus-filled dilated bronchi, areas of atelectasis related to bronchial obstruction from mucoid impaction, mass within a cavity and may demonstrate multiple aspergillomas in areas of extensive cavitary disease, halo sign.

CT scanning is also used to differentiate aspergillosis from other diseases: cavitary opacities- necrotizing infections (anaerobes) or in the transplant patient are due to rhodococcus, posttransplantation lymphoproliferative disorder, or CMV infection, Langerhans histiocytosis, metastatic tumour, septic embolism, Wegener's granulomatosis, tuberculosis, rheumatoid arthritis (necrobiotic nodule), sarcoidosis (less frequent)

Aspergillosis may be complicated by massive hemoptysis and bronchial angiogram with embolotherapy (using coils or gel foam) is temporizing, but surgical resection is definitive (bronchopleural fistula may result).

**Images for this section:**
Fig. 2: DODAN: -Extensive pulmonary condensation with lung parenchymal destruction. -Important retractable character LSS. Peribronchial thickening. -Apical cavity LSS (diameter ~ 5 cm), with a heterogeneous solid mass (or 2 adjacent), not fully determine the cavity filling. Adjacent to the LSS describe changes, polymorphic type traction bronchiectasis, nodules with irregular contours, fibrosis lesions, cavities imprecisely defined. -Trachea, large vessels, heart, drawn to the left. -Left apical pleural thickening

Fig. 3: DODAN: -Extensive pulmonary condensation with lung parenchymal destruction. -Important retractable character LSS. Peribronchial thickening. -Apical cavity LSS (diameter ~ 5 cm), with a heterogeneous solid mass (or 2 adjacent), not fully determine the cavity filling. Adjacent to the LSS describe changes, polymorphic type traction bronchiectasis, nodules with irregular contours, fibrosis lesions, cavities imprecisely defined. -Trachea, large vessels, heart, drawn to the left. -Left apical pleural thickening
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**Fig. 5:** FLOREA: - Multiple cavitary images confluent right upper lobe apical and posterior - Stands out particularly in the posterior segment of LSD ~ 4 cm cavity adjacent to an area of pleural thickening with a solid heterogenous content - "sponge-like" (small air leakage) - observation intracavitary aspergilloma (not fully occupy the cavity) - LSS, cavitary image apico-posterior splitted, anfractuos contour (or hollow images confluent) with diameter > 7 cm with a dense content (intracavitary mass aspect) not occupy the entire cavity (observation aspergillosis). Ground-glass rim surrounding nodules (halo-sign) - Adjacent pleural thickening. Conclusions: diagnosis oriented towards bilateral aspergillosis in caverns post TBC, LSD and LSS and fibrocavitare polymorphic modifications and bilateral nodular, traction bronchiectasis post TBC.
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(observation aspergillosis). Ground-glass rim surrounding nodules (halo-sign) - Adjacent pleural thickening. Conclusions: diagnosis oriented towards bilateral aspergillosis in caverns post TBC, LSD and LSS and fibrocavitare polymorphic modifications and bilateral nodular, traction bronchiectasis post TBC

**Fig. 9:** CRISTEA: - In the upper left lobe (boundary posterior and anterior segment), cavity with an irregular outline, retraction, ~ 3 cm diameter, containing a solid mass inside the cavity not all interested in leaving a crescent air leakage around. - Polymorphic changes in the LSS characterized by focal fibrosis, traction bronchiectasis, septal thickening, micro and macronodules and especially a cavern ~ 3cm, irregular wall, traction, with a solid content "sponge-like" suggesting intracavitary aspergilloma.
Fig. 10: CRISTEA: -In the upper left lobe (boundary posterior and anterior segment), cavity with an irregular outline, retraction, ~ 3 cm diameter, containing a solid mass inside the cavity not all interested in leaving a crescent air leakage around. -Polymorphic changes in the LSS characterized by focal fibrosis, traction bronchiectasis, septal thickening, micro and macronodules and especially a cavern ~ 3cm, irregular wall, traction, with a solid content "sponge-like" suggesting intracavitary aspergilloma.
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Fig. 12: GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). -Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5cm, which leaves a crescent at the upper pole. -Bilateral intracavitary aspergillosis.

Fig. 13: GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). -Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5cm, which leaves a crescent at the upper pole. -Bilateral intracavitary aspergillosis.
Fig. 14: GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). - Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5 cm, which leaves a crescent at the upper pole. - Bilateral intracavitary aspergillosis.

Fig. 15: GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). - Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5 cm, which leaves a crescent at the upper pole. - Bilateral intracavitary aspergillosis.
**Fig. 16:** GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). -Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5cm, which leaves a crescent at the upper pole. -Bilateral intracavitary aspergillosis.
**Fig. 17:** GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). - Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5cm, which leaves a crescent at the upper pole. - Bilateral intracavitary aspergillosis.
Fig. 18: GUZGA: - Apical macronodular LSD 3.5/3.75/3.9 cm, surrounded by an hypertransparency area, better visible at the upper pole as a crescent air leakage - intracavitary aspergilloma possible (with attachments linear lesion extended to the pleura apical). - Apical pleural thickening. - Culmen: retractable heterogeneous condensation, multiple cavities inside, the biggest > 6 cm, containing inside a mass of ~ 5cm, which leaves a crescent at the upper pole. - Bilateral intracavitary aspergillosis.
Conclusion

This poster is primarily targeted for general radiologists, but may appeal to anyone with a specific interest in cavitating pulmonary pathology and complications of tuberculosis. He is an overview of the Rx and CT imaging spectrum of aspergillosis.

Diagnosing an infection caused by aspergillus mold can be difficult and depends on the type of aspergillus infection. The radiologist plays a major role in the diagnosis of pulmonary aspergillosis. Imaging findings in various types of pulmonary aspergillosis may be nonspecific, but thin-section CT findings may help and suggest the specific diagnosis.

Personal information

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