Pulmonary aspergilloma: Imaging findings with pathologic correlation

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Objectives

Aspergilloma formation represents a saprophytic infection in patients with preexisting structural lung disease. Patients at risk for aspergilloma development have cavitary, bullous or cystic lung disease that is commonly a result of tuberculosis, sarcoidosis and emphysema. Aspergillomas have a reported prevalence of 50% in association with these diseases and are commonly encountered as solitary lesion primarily in the upper lobes (1). The associated morbidity and mortality are high because of massive hemoptysis with an overall mortality reported to be as high as 31% at 5 years. Early detection of mycetoma formation within fibrotic lung is therefore desirable (2).

The purpose of this study was to review the clinical, radiographic and computed tomographic (CT) manifestations of pulmonary aspergilloma and to correlate the imaging and pathologic findings.

Materials and Methods

During a fourteen-year period (1997 to 2012), there were sixty-five patients with pulmonary aspergilloma. The study group included 55 male and 10 female patients with a mean age of 56.7 years (ranging from 35 to 80 years). Chest radiographs (n: 65) obtained at presentation were reviewed by two chest radiologist (K.Ö and A.K). The observers assessed the number, size and wall thickness of pulmonary cavities and the presence of noncavitary nodules, irregular linear opacities, ground-glass opacities and air-space consolidations. The presence of airway abnormalities, lymphadenopathy, pleural and pericardial effusions and pneumothorax was also assessed.

CT scans were available in 65 patients. The CT examinations were performed with CT either a single slice CT (General Electric Medical Systems, Milwaukee, USA) (n: 33) or 64-slice CT (Siemens Sensation 64, Erlangen, Germany) (n: 32). Conventional 10-mm collimation scans in 33 patients and thin section CT scans (1.5 mm collimation with a high spatial-frequency reconstruction algorithm) in 32 patients were obtained.

Pathologic specimens were obtained in 20 patients. They included specimens obtained at lobectomy (n: 18), pneumonectomy (n: 2). All pathologic specimens reviewed by an experienced lung pathologist.

Results
Clinical Data

The most common symptoms included cough (n: 13), fever (n: 12) and shortness of breath (n: 10). Twenty patients (18.5 %) were free of symptoms. Twenty (18.5 %) of the 65 patients presenting hemoptysis had a history of minor and recurrent hemoptysis.

Various underlying diseases were observed in 65 patients; 58 presented with tuberculosis cavitation (89 %), 1 sarcoidosis, 1 rheumatoid arthritis, 1 astma and bronchiectasis, 2 Behçet's Disease and 2 had squamous cell carcinoma.

Serodiagnosis was positive in 20 patients, negative in 11 patients and equivocal in 34 patients.

Chest Radiographic Findings

The most common radiographic finding was cavitary lesions associated with fibroproductive (fibronodular and/or fibrocalcific) and nodular lesions in the apical and posterior segments of the upper lobes (Figure 1). Aspergilloma was seen only in 10 patients of 65 patients (Figure 1) and thick walled cavitary lesions associated with pleural thickening in areas adjacent to the aspergilloma cavity was seen in 40 patients (61%) (Figure 1). Atelectasis of a upper lobe and permanent lobar shrinkage (fibrosis) was noted on the radiographs in 15 patients (Figure 1). The common sites of intracavitary aspergillomas were in the upper lobes (Figure 1).

CT Findings

Of 65 patients with aspergillar disease of thorax, forty-three had a diagnosis of aspergilloma considering their chest CT examinations only, demonstrating the characteristic fungus ball with the air-crescent sign (Figure 1). In most patients, conventional radiograph failed to demonstrate the halo appereance around the aspergilloma. CT in these cases reveaeds irregular fungal strands connecting the aspergilloma to the surrounding cavity wall (Figure 2). In 63 patients, the cavities were beter delineated from surrounding abnormalities on the CT scan than on the radiographs (Figures 1, 2, 3). In 17 patients with aspergillomas (26 %) the lesions were bilateral (Figure 3). In 3 patients (4.5 %) there were multiple aspergillomas (Figure 4). In 40 patients the aspergilloma localized in the upper lobes. In one patient with a lifelong history of astma and diabetes mellitus, there were positive skin reactivity and blood eosinophilhi of 25 %. Chest CT scan showed postinfectious bronchectasis, involving the more distal airways and cystic bronchiectasis with typical aspergilloma. Clinical and CT findings were highly suggestive of allergic bronchopulmonary aspergillosis (ABPA) (Figure 5). This patient underwent surgery and histologic specimens were compared with the CT scans. Surgery confirmed the ABPA. In two patients (1Behcet's disease, 1 systemic lupus eritematosis) with underlying disease, chest CT scan showed typical intracavitary aspergillomas (Figures 6, 7). In these patients, bronchoscopic biopsy revealed the diagnosis of tuberculosis. In the remaining 2 patients had a cavitary lesion with the meniscus sign in the left lower lobe, the cavitary lesion showed irregularly thickened wall.
In these patients, microscopic examination revealed a squamous cell carcinoma in both the cavity wall and the fungus-ball like lesion (Figure 8). In 20 (35 %) of 58 patients with tuberculosis, histologic specimens were available. The CT findings were correlated with histologic examinations (Figures 1,3).

Fig. 1: Aspergilloma in a 60-year-old male with previous tuberculosis. (a) Chest radiography showed a fungus ball with trans radiant halo and extensive upper lobe fibrosis. (b-c) Prone CT showed a 2-cm intracavitary fungus ball (arrow) and very narrow transradiant halos (thin arrows) are better demonstrated on the right upper lobe. (d) A photograph of gross specimen of right upper lobectomy shows a large spongework intracavitary aspergilloma.

References: K. Ödev; Konya University Meram School of Medicine, Department of Radiology, Konya, TURKEY
Fig. 2: Aspergilloma in a 60-year-old man with previous tuberculosis. (a) Chest radiograph showed bilaterally an extensive pleural thickening in the upper lobes. (b) CT scan showed bilaterally spongework aspergillomas (arrows) in the right and left upper lobes. The fungus masses are connected to the cavity wall by numerous fronds of mycelia that obliterates halo and preclude diagnosis by tomography.

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Fig. 3: Bilateral aspergillomas in a 66-year-old with residual tuberculosis. (a) Chest radiograph showed a large opacity in the right upper lobe (white arrow) and a small
opacity in left upper lobe (white arrow). (b) Axial CT showed large cavities bilaterally with a characteristic air crescent sign between the aspergilloma and the cavity wall (white arrows). Note the marked pleural thickening surrounding the cavity.

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![Fig. 4](image)

**Fig. 4:** Aspergilloma in a 65-year-old male with tuberculosis. (a-b) Supine and prone CT scans showed multiple intracavitary aspergillomas (arrows) and extensive fibrosis.

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**Fig. 5**: ABPA in a 50-year-old female with asthma and diabetes mellitus with allergic bronchopulmonary aspergillosis. (a-b) Prone and supine CT scans showed saccular bronchiectatic areas (short arrow) with associated mobile aspergilloma (long arrow) filling cystic bronchiectatic cavitary lesion. The presence of saccular bronchiectasis is highly suggestive of ABPA. Despite steroid therapy, patient presented with extensive hemorrhage and recurrent pneumonies. Thus, she required surgical operation and lower lobectomy in 2003. (c) Photograph of the corresponding gross surgical specimen demonstrated fungus ball. (d-e) Follow up CT scans (2007-2012) showed central cystic bronchiectatic areas with intracavitary masses, undoubtedly fungus ball in the left upper lobe (arrow). New areas of left upper lobe presumed due to allergy. Surgical intervention was considered unnecessary, and antifungal and antiallergic treatment was administrated over a three-week interval prior to discharge. Three years later she was readmitted because of a recurrence of hemoptysis and productive cough. The patient refused the surgery. Thus, she was treated conservatively with antifungal and antiallergic treatment. She has been following up.

**References**: K. Ödev; Konya University Meram School of Medicine, Department of Radiology, Konya, TURKEY
Fig. 6: Aspergilloma due to Behcet's Disease in a 40-year-old male. Immunosuppressive therapy (chemotherapy) of the treatment of Behcet's Disease was given to the patient. After the complement of the treatment, pulmonary tuberculosis occurred at the right lung. During the high dose antituberculosis treatment, chest CT scan demonstrated a cavitary lesion with associated fungus ball (arrow) suggesting fungal disease. Broncoscopic aspiration was performed. Special stains were positive for aspergillus and acide-fast bacilli.

References: K. Ödev; Konya University Meram School of Medicine, Department of Radiology, Konya, TURKEY
Fig. 7: Mobile mycetoma in a cavitary pulmonary tuberculosis in a 70-year-old female with systemic lupus erythematosus. (a) Axial CT scan showed cavitary lesion (arrow) in the right upper lobe (2006). (b) Follow-up coronal reformatted CT scan demonstrated a change in the position of intracavitary aspergilloma (arrow). Special stains were positive for aspergillosis and acide-fast bacilli.

References: K. Ödev; Konya University Meram School of Medicine, Department of Radiology, Konya, TURKEY

Fig. 8: Cavitary lung cancer with an aspergilloma-like shadow in a 60-year-old male. (a) CT scans showed a 3 cm peripheral cavitary lesion containing a mural nodule (arrow) in the left lower lobe. (b) F-18 FDG image showed hypermetabolic activity on the wall of the cavity (arrow). Surgery revealed a squamous-cell carcinoma with associated fungus ball.

References: K. Ödev; Konya University Meram School of Medicine, Department of Radiology, Konya, TURKEY
Conclusions

Aspergillosis is an infection produced by the common soil fungus, *Aspergillus*. Although any organ can become infected with *Aspergillus*, the lungs are the most common site. Mycetomas develop as a result of colonization and proliferation of *Aspergillus* in pre-existing pulmonary cavities or bronchiectatic airways (2, 3). In one study, 15-20% of patients with healed tuberculosis had sizable residual cavities (greater than 2.5 cm) that eventually developed aspergillomas (3, 4). The most common underlying causes are tuberculosis, sarcoidosis, emphysema, bullae or lung cysts, broncogenic cyst, pulmonary sequestration and cavitary broncogenic carcinoma, pulmonary infarction, other fungal diseases and apical fibrosis of ankylosing spondylitis (3, 4, 5). In this study, sixty-three patients presented with a bronchial aspergilloma with additional underlying disease. Aspergilloma also occurs in patients with underlying allergic bronchopulmonary aspergillosis (ABPA) (3). ABPA occurred in one patient in this study. The classic radiographic appearance of an aspergilloma is that of a discrete round or oval density occupying a large or small part of an upper lobe pulmonary cavity. The middle and lower lobes are occasionally involved. Aspergilloma can be multiple or bilateral. Pleural thickening in areas adjacent to the aspergilloma cavity is common and may accompany or precede the appearance of a fungus ball. Not all aspergillomas appear typically as an intracavitary mass. Three different series of patients with proved aspergilloma have described a variety of other appearances, such as poorly defined intracavitary densities, intracavitary air-fluid levels, radiographically empty cavities and absence of a radiographically recognizable cavity (occult aspergilloma) (6, 7, 8).

CT is often necessary to demonstrate the fungus ball in patients with clinically suspected aspergilloma and nonspecific plain film findings (3). Our results confirmed that chest radiograph is unsensitive for detection of mycetomas. The superiority of CT over other imaging techniques for the detection of a mycetoma is obvious. However, the most frequently performed imaging investigation in patients with post-primary tuberculosis or fibroproductive lesions is the chest radiograph. Our results indicate if an aspergilloma is not obvious on chest radiograph in such patients, should be made further investigation with CT. The differential diagnosis in a patient with intracavitary mass at radiograph or CT should include hydatic cyst, Candida fungus ball, cavitating neoplasm, pulmonary abscess and hemorrhage in a noninfected cavity.

In conclusion, the superiority of CT over conventional radiograph is obvious. However, tuberculosis still exists in medically advanced countries, particularly in large urban population. Therefore, the most frequently performed imaging modality in patients with chronic lung disease associated with tuberculosis is the chest radiograph. CT is often necessary to show the fungus ball in patients with clinically suspected aspergilloma. The radiologic differential diagnosis of a mycetoma includes hydatic cyst hematoma, chronic abscess and cavitating neoplasm.
References


