Imaging studies with pathologic correlations showing the numerous different manifestations of pulmonary aspergillosis

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ABSTRACT

Depending on the patient's underlying immunological status, the burden of the organisms, and the underlying condition of the lungs, a pulmonary aspergillus infection might present itself in a number of different ways. Discussion: Patients who have a hyperimmune condition are often the ones that are diagnosed with hypersensitivity pneumonitis and allergic bronchopulmonary aspergillosis (ABPA) (asthma, atopy and hyper-eosinophilia). Patients who already have lung damage and cavities, most frequently as a result of a previous case of tuberculosis or sarcoidosis, are more likely to develop aspergilloma or mycetoma. In immunocompromised people, an infection with Aspergillus can manifest as either a semi-invasive or an invasive form of aspergillosis (angioinvasive and airway invasive, respectively). In this article, we correlate the radiologic findings of the various pulmonary manifestations of Aspergillus infection with their pathologic aspects to get a deeper comprehension of the disease process and a better understanding of the imaging patterns that are associated with it.

Keywords: Aspergillosis; Radiology; Pathology, Pulmonary.

INTRODUCTION

The aspergillus fungus is quite common and can be discovered in dust, soil, and decaying vegetation. The respiratory tract is the route through which the fungus can enter the body, but the sickness will not normally present itself unless the fungus comes into contact with damaged lungs or an impaired immune system [1].

The frequency of hematopoietic stem cell and solid organ transplants has increased dramatically over the past few decades, which may be one factor that has contributed to the significant increase in the incidence of fungal infections [2]. Aspergillosis is the most common fungal illness seen in patients who have had stem cell transplants [3,] and the second most common fungal infection seen in patients who have received solid organ transplants. In immunocompromised patients, getting an early diagnosis and starting treatment as soon as possible is essential in order to reduce the risk of potentially fatal infections.[4]

The patient's clinical presentation, as well as the radiologist's and pathologist's ability to recognise the various radiological and pathological findings, can enable the radiologist make an accurate diagnosis and begin potentially lifesaving antifungal treatment.

DISCUSSION

Immune status and spectrum of disease

Both the likelihood of developing pulmonary aspergillosis and the radiologic imaging spectrum are subject to change depending not only on the immunological

status of the patient but also on the state of their lungs.

Allergic bronchopulmonary aspergillosis

The hypersensitivity reaction known as allergic bronchopulmonary aspergillosis (ABPA) is caused by the fungus Aspergillus, most specifically A. fumigatus. Patients typically wheeze, cough, complain of pain, or have a low-grade fever when they report to the clinic, and they almost always have a lengthy history of asthma. The presence of peripheral eosinophilia, increased serum IgE levels, and skin reaction to Aspergillus antigen may be uncovered by laboratory testing [5]. Steroid therapy is typically used as the treatment for hypersensitivity reactions, however some of the newer antifungal drugs also show promise [6,7]. Steroid therapy is used to reduce the severity of the hypersensitivity reaction.

Radiologic features: Plain radiographs are not as sensitive in the early stages of the illness process, therefore they may simply show a thickening of the airways and hyperinflation that are suggestive of asthma. In more advanced stages of the disease, central tubular opacities can appear in a branching pattern, most frequently in the higher lobes. These findings indicate that the patient has central bronchiectasis with mucoid impaction, which is more often known as the "finger in glove sign" [8-10].

High attenuation mucus in the setting of chronic fungal infection was first described in the setting of chronic fungal sinusitis. It is believed to represent calcium and/or metallic ions from the fungus that are contained within the inspissated mucus [11]. Chronic fungal sinusitis was the initial setting in which high attenuation mucus was described. There are a number of potential differential diagnoses, including bronchial atresia, TB, and various endobronchial disorders. On CT, a miliary pattern may occasionally be seen in patients with severe ABPA [12].

Pathologic features: In the setting of some diseases, a wide variety of histologic alterations may be observed. ABPA, which includes mucoid impaction of the airways, allergic mucin, and other related conditions pneumonia with eosinophils, bronchocentric granulomatosis, and bronchiolitis bronchiolitis, both acute and chronic [13-16].

Aspergilloma

Mycetomas, often known as "fungus balls," are a type of mycetoma that are typically caused by a saprophytic (non-invasive) colonisation by A. fumigatus. An aspergilloma is one type of mycetoma. Patients having underlying lung injury, most typically cavities from previous tuberculosis or sarcoidosis that are colonised by the organism, are more likely to develop aspergillomas. Preexisting pneumatoceles, pulmonary sequestration, or bronchogenic cysts are some of the other rare factors that could be responsible [10]. Patients who have an aspergilloma typically appear with hemoptysis, which can be treated with bronchial artery particle embolization or surgical resection [17]. Hemostasis is the most prevalent symptom that is experienced by patients.

Radiologic features: The findings of a plain radiograph could demonstrate pleural thickening, notably in the lung apices. Mycetomas are distinguished by the presence of a mass of soft tissue within a hollow that was already present [18]. It is possible for the mass to relocate itself within the cavity as the patient shifts positions. The crescentic lucency that surrounds the periphery of the mass that is butting up against the wall of the cavity is a

reflection of the air that is present between the fungus ball and the wall of the space. This discovery was first observed by Monod and colleagues [19] and was conventionally labelled as "Monod's Sign." However, the term "air crescent sign," which is also used to denote improved angioinvasive aspergillosis, is often used interchangeably [20].

Pathologic features: The proliferation of fungal hyphae to generate a mass of fungal components inside of a preexisting space, cyst, or dilated airway is the histologic signature of either an aspergilloma or a mycetoma [10]. [citation needed] Because of this, mycetoma is often diagnosed through the process of surgical lung biopsy. In most cases, the wall of the gap will be fibrotic and will have a diminished epithelial lining. Within the cavity's wall, there is frequently an infiltration of cells demonstrating low-grade inflammation. Because the mass of fungal elements may frequently be recognised by hematoxylin and eosin staining alone, the use of fungal stains is not as common as it formerly was.

Semi-invasive aspergillosis

Patients who have modest immunosuppression, such as those who have diabetes mellitus, chronic malnutrition, alcoholism, or who have been receiving chronic steroid therapy, are more likely to develop semi-invasive aspergillosis, which is also known as chronic necrotizing aspergillosis. Patients who already have a history of lung disease, most often COPD, may be at an increased risk [18]. Patients come to the emergency room complaining of ongoing fever, cough, and general malaise. The treatment comprises of antifungal medication being administered.

Radiologic features: Imaging signs, such as those shown on an X-ray or CT scan, are not specific and can be mistaken for tuberculosis. The term "chronic necrotizing aspergillosis" alludes to the fact that areas of consolidation frequently progress to necrosis in the centre, generating cavities that may or may not include a mycetoma [21].

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Invasive aspergillosis

The presence of significant immunosuppression, in particular neutropenia, is associated with the development of invasive aspergillosis. Patients who are at risk for invasive Aspergillus infections include those who are receiving extended high-dose steroids, patients who have had transplantation, patients who are undergoing immunosuppressive chemotherapy, and patients who have reached the end stage of AIDS [22]. Because this symptom of an Aspergillus infection might result in death in a short amount of time, it is essential to start antifungal treatment as soon as possible and, if at all feasible, to reverse immunosuppression.

There are two distinct presentations of invasive aspergillosis, and each one is determined by whether the most prominent symptom is an invasion of the blood vessels or the airways. The clinical manifestations of airway invasive aspergillosis are tracheobronchitis, bronchiolitis, or bronchopneumonia [23]. This kind of aspergillosis is significantly less prevalent than angio-invasive aspergillosis.

Radiologic features: The results of a plain radiograph in patients with invasive aspergillosis are typically vague. The airway invasive form may appear with thickening of the airways, consolidation, and nodules, whereas the angio-invasive form typically shows scattered nodular and mass-like areas of consolidation. In addition, nodules may be present in the airway invasive form. Findings of airway invasive illness on CT remain non-specific, and a conclusive diagnosis based on a prospective examination may not be possible.

Pathologic features: The presence of fungal components invading through the artery wall within tissues is what distinguishes angio-invasive aspergillosis from other types of aspergillosis [24]. Because of this, severe tissue necrosis and necrotic debris, together with neutrophilic inflammation, are frequently the outcomes. The organisms that live within the wall of vessels can be made more visible by the presence of fungal stains. Miliary aspergillosis is another name for angio-invasive aspergillosis, which is a subtype of the disease. Miliary disease is characterised by the random distribution of a large number of nodules of a comparable size across the lung parenchyma. The nodules are made up of necrosis that resembles an infarct and inflammatory debris that is connected with them. Granulomatous degeneration may accompany the inflammatory process in certain instances. The presence of fungal elements at the heart of these necrotic nodules is frequently highlighted by fungal stains, which are likely the result of hematogenous spread.

CONCLUSION

The radiologic and pathologic features that are linked with the numerous distinct presentations of pulmonary aspergillosis have been outlined in this article. This association between radiology and pathology will assist the reader in comprehending how underlying histological findings give rise to radiographic signs that are frequently distinctive of the various types of pulmonary aspergillosis. Another important goal of this paper is to demonstrate how the pulmonary manifestations of aspergillosis are frequently dependant on the patient's underlying immunological condition as well as the health of the underlying lungs. This is meant to be a major takeaway for readers. In the appropriate clinical scenario, the imaging findings described in this paper may help the radiologist suggest the diagnosis and initiate prompt life-saving treatment, as well as avoid unnecessary delay or incorrect treatment regimens. These benefits can be achieved by avoiding unnecessary delay or incorrect treatment regimens. This is of utmost importance in the immunocompromised population, since even a few hours' delay might spell the difference between life and death in these cases.

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