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Pulmonary Aspergillosis: A Short Review

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Abstract

Pulmonary aspergillosis refers to a spectrum of diseases resulting from *Aspergillus* becoming resident in the lung. These include invasive aspergillosis from angioinvasive disease, simple aspergilloma from inert colonization of pulmonary cavities, and chronic cavitary pulmonary aspergillosis from fungal germination and immune activation. Chronic pulmonary aspergillosis includes simple aspergilloma, which is occasionally complicated by life-threatening hemoptysis, and progressive destructive cavitary disease requiring antifungal therapy. Allergic bronchopulmonary aspergillosis occurs almost exclusively in patients with asthma or cystic fibrosis. Invasive aspergillosis is now recognized to occur in patients with critical illness without neutropenia and in those with mild degrees of immunosuppression, including from corticosteroid use in the setting of COPD. Improvement in outcomes for Aspergillus pulmonary syndromes requires that physicians recognize the varied and sometimes subtle presentations, be aware of populations at risk of illness, and institute potentially life-saving therapies early in the disease course.

Key words: *Pulmonary aspergillosis, Aspergilloma, Colonization, Immunosuppression*

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1. Introduction

Pulmonary aspergillosis refers to a spectrum of diseases resulting from *Aspergillus* becoming resident in the lung. These include invasive aspergillosis from angioinvasive disease, simple aspergilloma from inert colonization of pulmonary cavities, and chronic cavitary pulmonary aspergillosis from fungal germination and immune activation. *Aspergillus* is a ubiquitous and hardy organism [1]. It grows best in moist environments, although spore aerosolization and dispersion occur most effectively in dry climates. Spores survive harsh external conditions and adapt to a range of internal environments [2]. Although there are hundreds of *Aspergillus* species, *Aspergillus fumigatus* is by far the most common pathogenic species in humans, where the small size and hydrophobicity of its spores confer a dispersion advantage [3]. Although less common, *Aspergillus flavus* and *Aspergillus niger* also contribute to the total burden of pulmonary aspergillosis.

2. Invasive pulmonary aspergillosis (IPA)

Invasive pulmonary aspergillosis (IPA) is a severe disease, and can be found not only in severely immunocompromised patients, but also in critically ill patients and those with chronic obstructive pulmonary disease (COPD). Chronic necrotizing aspergillosis (CNA) is locally invasive and is seen mainly in patients with mild immunodeficiency or with a chronic lung disease. Aspergilloma and allergic bronchopulmonary aspergillosis (ABPA)

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are noninvasive forms of Aspergillus lung disease. Aspergilloma is a fungus ball that develops in a pre-existing cavity within the lung parenchyma, while ABPA is a hypersensitivity manifestation in the lungs that almost always affects patients with asthma or cystic fibrosis [4]. IPA was first described in 1953 [5]. Due to widespread use of chemotherapy and immunosuppressive agents, its incidence has increased over the past two decades [6, 7]. The most important risk factor is neutropenia, especially when there is an absolute neutrophil count of 500 cells/mm^3. The risk of IPA correlates strongly with the duration and degree of neutropenia. The risk in neutropenic patients is estimated to increase by 1% per day for the first 3 weeks and by 4% per day thereafter [8]. Hemopoietic stem cell transplantation (HSCT) and solid-organ transplantation (especially lung transplantation) are also significant risk factors [9]. Several other factors also predispose patients with transplantation to acquire IPA: multiple immune defects including prolonged neutropenia in the pre-engraftment phase of HSCT; the use of multiple anti-rejection or anti-graft versus host disease (GVHD) therapy (such as corticosteroids and cyclosporine); parenteral nutrition; use of multiple antibiotics; and prolonged hospitalization.

3. Chronic Necrotizing Aspergillosis (CAN)

Chronic necrotizing aspergillosis (CAN), also called semi-invasive or subacute invasive aspergillosis, was first described by Binder et al. [10] in 1982. It is an indolent, cavitary and infectious process of the lung parenchyma secondary to local invasion by *Aspergillus* species, usually *A. fumigatus*. In contrast to IPA, CNA runs a slowly progressive course over weeks to months, and vascular invasion or dissemination to other organs is unusual. This syndrome is rare, and the available literature is based on case reports and small case series [11]. CNA usually affects middle-aged and elderly patients with altered local defenses associated with underlying chronic lung diseases, such as COPD, previous pulmonary tuberculosis, thoracic surgery, radiation therapy, pneumoconiosis, cystic fibrosis, lung infarction or sarcoidosis [12]. It may also occur in patients who are mildly immunocompromised due to diabetes mellitus, alcoholism, chronic liver disease, low-dose corticosteroid therapy, malnutrition, or connective tissue diseases, such as rheumatoid arthritis and ankylosing spondylitis [8].

4. Aspergilloma

Aspergilloma is the most common and best recognized form of pulmonary involvement by *Aspergillus* species, and it usually develops in a pre-existing cavity in the lung. The aspergilloma (fungus ball) is composed of fungal hyphae, inflammatory cells, fibrin, mucus, and tissue debris. The most common species of *Aspergillus* recovered from such lesions is *A. fumigatus*. However, other fungi, such as *zygomycetes* and *Fusarium*, may cause the formation of a fungal ball. Many cavitary lung diseases are complicated by aspergilloma, including tuberculosis, sarcoidosis, bronchiectasis, bronchial cysts and bullae, ankylosing spondylitis, neoplasm, and pulmonary infection [13]. Of these, tuberculosis is the most common [14].

5. Allergic bronchopulmonary aspergillosis (ABPA)

Allergic bronchopulmonary aspergillosis (ABPA) is a pulmonary disease that results from hypersensitivity to *Aspergillus* antigens, mostly due to *A. fumigatus.* The majority of cases occur among people with asthma or cystic fibrosis. It is estimated that 2% of asthmatics, and 7–14% of corticosteroid-dependent asthmatics have ABPA. Also, the incidence of ABPA is higher in patients with atopy [15]. In the case of cystic fibrosis, 1–15% of patients may develop ABPA [16].

6. Diagnostic approach

The diagnosis of pulmonary aspergilloma is usually based on clinical and radiographic features along with serological or microbiological evidence of *Aspergillus* Spp. Chest radiography is useful in demonstrating the presence of a mass in a pre-existing cavity. Aspergilloma appears as an upper-lobe, mobile, intra-cavitary mass with an air crescent in the periphery [17]. A change in the position of the fungus ball after moving the patient from supine to prone position is an interesting but variable sign. Chest CT scan may be necessary to visualize aspergilloma that is not apparent on chest radiograph [18].

Conclusion:

Aspergillus is a ubiquitous organism that is encountered regularly in the environment. Pre-existing lung disease or immune dysfunction have long been recognized as prerequisites for the development of pulmonary disease in response to *Aspergillus.* Improvement in outcomes for Aspergillus pulmonary syndromes requires that physicians recognize the varieties and subtle presentations of the disease, be aware of the populations at risk of the illness, and institutional potential for early diagnosis and life-saving therapies in the disease course.

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