Aspergillus fumigatus

Aspergillus is a genus of monomorphic fungi named after the shape of an aspergillum, which is an instrument used to sprinkle holy water. Aspergillus fumigatus is one of the most common Aspergillus species to cause disease. Its spores are ubiquitous in the atmosphere and estimated that everybody inhales several hundred spores daily. The most common forms of disease are allergic bronchopulmonary aspergillosis, pulmonary aspergilloma, and invasive aspergillosis. On microscopy, Aspergillus can be identified by their septate hyphae that tend to have dichotomous branches at primarily acute angles of about 45 degrees. The organisms can also demonstrate fruiting bodies which are the conidial heads that produce spores. Allergic bronchopulmonary aspergillosis is associated with hypersensitivity to the spores of Aspergillus molds, commonly seen in asthmatics. It is characterized by numerous eosinophils and elevated IgE directed against Aspergillus antigens. Thick mucus plugs can develop and overtime cause the bronchi to become dilated leading to bronchiectasis. Aspergilloma refers to growth of the fungus within a cavity of the lung, previously formed during an illness such as tuberculosis. The spores penetrate the cavity and germinate, causing the formation of a fungal ball within the cavity. Within the cavity, the fungus secretes toxic and allergic products. Hemoptysis is common, occurring in 50-80% of affected individuals. Invasive aspergillosis occurs in immunocompromised individuals including people with chronic granulomatous disease where the fungus transfers from the lungs to the bloodstream and can disseminate to the brain or other organs. Within the blood vessels, the organism can cause hemorrhagic infarctions and cause necrotizing bronchopneumonia in the lungs.

PLAY PICMONIC

Characteristics

Fungi
Fun-guy
Aspergillus is a genus of monomorphic fungi.

Monomorphic
Mono-morphic-man
Unlike other systemic fungal infections, Aspergillus is a monomorphic fungus that exists only in the mold form (and not in the yeast form). Fungi that can exist as both mold and yeast forms are called “dimorphic”.

Septate Hyphae
Scepter
On microscopy, Aspergillus organisms can be identified by their septate hyphae.

Branch at Acute Angles
Branches at an Acute Angle
On microscopy, Aspergillus’ septate hyphae tend to have dichotomous branches at primarily acute angles of about 45 degrees.

Fruiting Bodies
Fruiting-tree
The organisms can also demonstrate fruiting bodies which are the conidial heads that produce spores.

Disease

Allergic Bronchopulmonary Aspergillosis (ABPA)
Allergy-alligator with Asparagus
Allergic bronchopulmonary aspergillosis (ABPA) is associated with hypersensitivity to the spores of Aspergillus molds, commonly seen in asthmatics. It is characterized by numerous eosinophils and elevated IgE directed against Aspergillus antigens. ABPA may present with pulmonary symptoms including cough productive of brown bronchial mucous casts, rhinosinusitis, or nonspecific symptoms. Management includes steroids with possible antifungal therapy (-azoles).

Eosinophilia

Eosinophilia-eagle

Allergic bronchopulmonary aspergillosis is characterized by numerous eosinophils, which are white blood cells that combat multicellular parasites and play a role in allergies and asthma.

Increased IgE

(IgE) Electric-goblin

ABPA is characterized by an increase in IgE. The main function of IgE is immunity to parasites. It plays an essential role in type I hypersensitivity reactions.

Glucocorticoids +/- Azoles

Glue-quarter on Steroids

Steroids are the mainstay of treatment for patients with ABPA because they help reduce the mucosal inflammation. An oral route is preferred over an inhaled route. Itraconazole may be added to the treatment regimen.

Pulmonary Aspergillosis

Lungs and Asparagus

Pulmonary aspergillosis is usually chronic and manifests radiologically as nodules, cavities, or an aspergilloma. Often, pulmonary symptoms such as cough, shortness of breath, or recurrent pneumonia will lead to a chest x-ray or CT to reveal these pathologies. If a patient is asymptomatic and the disease is not progressing radiographically, then no treatment is necessary. However, the definitive treatment for aspergilloma is surgical resection with pre- and postoperative antifungal therapy (e.g. voriconazole, itraconazole).

TB Cavity

TB-TV cavity

Tuberculosis (TB) is a common cause of previous lung parenchyma cavity formation. As such, Aspergillus spores can penetrate the cavity and germinate, causing the formation of a fungal ball (i.e. aspergilloma) within the cavity.

Lung Aspergilloma

Asparagus-gnome in Lungs

Aspergilloma refers to growth of the fungus within a cavity of the lung, previously formed during an illness such as tuberculosis. Other cavitary conditions can also predispose to aspergilloma formation, including chronic pulmonary aspergillosis itself. The spores penetrate the cavity and germinate, causing the formation of a fungal ball within the cavity. Multiple lung nodules may also be apparent.

Hemoptysis

Red-mop Coughing Blood

In an aspergilloma, hemoptysis is common due to secretion of toxins and allergic products within the cavity. Hemoptysis occurs in 50-80% of affected individuals.

Invasive Aspergillosis

Invading Asparagus

Invasive aspergillosis occurs in immunocompromised individuals including people with chronic granulomatous disease where the fungus transfers from the lung to the bloodstream and can disseminate to the brain or other organs. Serum assays for galactomannan and 1,2-beta-D glucan antigens are useful in diagnosis although histological/culture evidence remains the best for confirmation. This can be obtained via biopsy or bronchoalveolar lavage. The best treatment is intravenous voriconazole.

AIDS/Immunocompromised

Band-AIDS

Invasive aspergillosis typically only affects individuals with immunodeficiencies, such as AIDS patients, individuals with bone marrow transplant or after chemotherapy.

Chronic Granulomatous Disease

Crone Granny-llama

Chronic granulomatous disease is an immunodeficiency caused by a lack of NADPH oxidase. Individuals with this disease are susceptible to invasive aspergillosis.

Hemorrhagic Infarction

Hemorrhage-hammer and Infarction-fart

Aspergillus has a tendency to invade blood vessels and can lead to hemorrhagic infarction in the lungs, which are occlusions of blood vessels with red blood cells entering the area of the infarct. Hemorrhagic infarctions are commonly seen in the lungs due to dual circulation of blood.

Necrotizing Bronchopneumonia

Necrosis-crow with Broccoli-nude-Mona

Invasive aspergillosis can lead to necrotizing bronchopneumonia with sharply delineated borders. Because Aspergillus has a tendency to invade blood vessels, there are typically areas of hemorrhage and infarction superimposed on areas of necrotizing, inflammatory tissue.

Voriconazole +/- Caspofungin

Volcano-easel and Casper-fun-guy

Intravenous voriconazole is the go-to treatment for patients with invasive aspergillosis. IV amphotericin B or isavuconazole may also be used. Otherwise, IV caspofungin is an option either as second line or in combination with voriconazole.