An overview on fungal disease

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INTRODUCTION

Fungi present everywhere as moulds, they grown in house and on foods in the form of yeasts, they are found in our body. Even mushrooms are classified as fungi although most of them are quite harmless. The fungal infections are common and generally mild. However, in very sick or otherwise immune suppressed people, fungi can sometimes cause serious infections. Many different kinds of fungi live in different geographic areas. Whatever form fungi take, they survive by breaking down organic matter. Only 300 out of the 1.5 million known species of fungi can cause disease in people. Mainly azole derivatives are used to treat fungal infection. Antifungal agents are available as various forms like creams, pessaries, shampoos, medicines to take by mouth, and injections. Nowadays newer antifungal agents also used to treat fungal disorders.

History

Fungal infections or mycoses are the great neglected diseases of medical history. There are numerous histories of viral, bacterial and protozoan infections, for all times and all places, but very few studies of those caused by fungi. It cannot be because of prevalence. Historical sources and contemporary epidemiological investigations show that fungal infections were and are ubiquitous. Everyone will have heard of, if not suffered from, athlete’s foot or thrush. In the first half of the twentieth century, children feared the school nurse finding ringworm on their scalp and having to endure, not only the pains of X-ray depilation or embarrassment of having their shaven head painted mauve with gentian violet, but also exclusion from school and the shame of being stigmatized as ‘unclean’. The neglect of serious fungal infections might be explained by their relative rarity, but this situation is changing rapidly with invasive candidiasis and aspergillosis becoming increasingly prevalent in critically ill patients and those with compromised immune systems.

Types of Fungal Diseases

Fungi present everywhere. There are approximately 1.5 million different species of fungi on Earth, but only about 300 of those are known to make people sick. Fungal diseases are often caused by fungi that are common in the environment. Fungi live outdoors in soil and on plants and trees as well as on many indoor surfaces and on human skin. Most fungi are not dangerous, but some types can be harmful to health.

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Aspergillosis
It is caused by the fungus Aspergillus and usually occurs in people with lung diseases or weakened immune systems. The different kinds of aspergillosis can cause different symptoms. Symptoms of allergic Broncho pulmonary Aspergillosis (ABPA) may include Wheezing, Coughing, and Fever. Symptoms of invasive aspergillosis may include Fever, Chest pain, Coughing, Shortness of breath, Aspergilloma, or “fungus ball”. It is difficult to avoid breathing in normal levels of Aspergillus spores. For people with weakened immune systems or severe lung diseases, there are steps that can be taken to help reduce exposure, including wear an N95 mask when near or in a dusty environment such as construction sites, avoid activities that involve close contact to soil or dust, such as yard work or gardening, Use air quality improvement measures such as HEPA filters, Take prophylactic antifungal medication if deemed necessary by your healthcare provider, Clean skin injuries well with soap and water, especially if the injury has been exposed to soil or dust of affected tissue or samples of respiratory secretions might be analyzed in a laboratory.

Blastomycosis
Caused by the fungus Blastomyces dermatitidis, which lives in moist soil and rotting wood and leaves in parts of the U.S. and Canada. Only with about half of the people who are infected with blastomycosis will show symptoms. If symptoms occur, they usually appear between 3 and 15 weeks after being exposed to the fungus. The symptoms of blastomycosis are similar to flu symptoms, and include fever, chills, cough, muscle aches, joint pain, and chest pain. In very serious cases of blastomycosis, the fungus can disseminate (spread) to other parts of the body, such as the skin and bones. There is no vaccine to prevent blastomycosis. However, people who have weakened immune systems may consider avoiding wooded areas where the fungus is prevalent [5-6].

Candidiasis (Oral Candidiasis)
Caused by yeasts that belong to the genus Candida. The most common species is Candida albicans. Candidiasis that develops in the mouth or throat is called “thrush” or oropharyngeal candidiasis. This infection is uncommon among healthy adults. Candida yeasts normally live on the skin or mucous membranes in small amounts. However, if the environment inside the mouth or throat becomes imbalanced, the yeasts can multiply and cause symptoms. Candida overgrowth can also develop in the esophagus, and this is called Candida esophagitis, or esophageal candidiasis. Candida infections of the mouth and throat can manifest in a variety of ways. The most common symptom of oral thrush is white patches or plaques on the tongue and other oral mucous membranes. Other symptoms include Redness or soreness in the affected areas, Difficulty swallowing, Cracking at the corners of the mouth. Good oral hygiene practices may help to prevent oral thrush in people with weakened immune systems. Some studies have shown that chlorhexidine (CHX) mouthwash can help to prevent oral candidiasis in people undergoing cancer treatment. People who use inhaled corticosteroids may be able to reduce the risk of developing thrush by washing out the mouth with water or mouthwash after using an inhaler [15].

Vaginal Yeast Infections
Genital/vulvovaginal candidiasis (VVC) is also sometimes called a “yeast infection,” and it occurs when there is a overgrowth of the normal yeast in the vagina. This infection is relatively common for all adult women have had at least one “yeast infection” in their lifetime. Women with VVC usually experience genital itching, burning, and sometimes a "cottage cheese-like" vaginal discharge. Men with genital candidiasis may experience an itchy rash on the penis. The symptoms of VVC are similar to those of many other genital infections, so it is important to see the doctor if have any of these symptoms. Wearing cotton underwear may help to reduce the risk of developing a yeast infection.

Bloodstream Candidiasis [Invasive Candidias]
Invasive candidiasis is a fungal infection that can occur when Candida yeasts enter the bloodstream. Once the fungus is in the bloodstream, it can spread to other parts of the body and cause infection. The symptoms of invasive candidiasis are not specific. Fever and chills that do not improve after antibiotic therapy are the most common symptoms. If the infection spreads to other organs or parts of the body such as kidneys, liver, bones, muscles, joints, spleen, or eyes, additional symptoms may develop, which vary depending on the site of infection. If the infection does not respond to treatment, the patient’s organs may stop working. Antifungal prophylaxis may be
appropriate for some groups of people who are at high risk of developing candidemia, such as low-birth-weight infants. Doctors and nurses can follow CDC-recommended infection control steps every time they work with a central line. Patients and caregivers can ask if a central line is needed and, if so, how long it should stay in place. They can also make sure that healthcare professionals wash their hands before they care for the central line.

**Coccidioidomycosis [Valley Fever]**
Caused by Coccidioides, a fungus found in the soil of dry, low rainfall areas. It is common in the southwestern U.S., Mexico, and Central and South America. In extremely rare cases, the fungal spores can enter the skin through a cut, wound, or splinter and cause a skin infection. Fatigue (tiredness), Cough, Fever, Shortness of breath, Headache, Night sweats, Muscle aches or joint pain, Rash on upper body or legs. If you have symptoms that you think may be caused by Coccidioides, you should see a doctor.

**Neoforans cryptococcosis**
Caused by Cryptococcus neoforans, a fungus that lives in soil throughout the world. Cryptococcal meningitis is serious problem in resource-limited countries with a high burden of HIV/AIDS. Infection with C. neoforans may cause a pneumonia-like illness. Symptoms include shortness of breath, cough, and fever. C. neoforans can also infect the central nervous system and cause inflammation of the brain and meninges, which is called meningoencephalitis. Symptoms of a central nervous infection may include fever, headache, or a change in mental status. It is difficult to prevent exposure to C. neoforans because it is present throughout the environment. However, people who have weakened immune systems should avoid areas contaminated by bird droppings, and should avoid contact with birds. If you have symptoms that you think may be caused by C. neoforans, you should see a doctor.

**Gattii cryptococcosis**
Caused by Cryptococcus gattii, a fungus that lives in soil in tropical and sub-tropical regions of the world, the U.S. Pacific Northwest, and British Columbia. The most common symptoms of C. gattii infection include shortness of breath, cough, fatigue, fever, and headache. C. gattii can also infect the central nervous system and cause inflammation of the brain and meninges, which is called meningoencephalitis. Symptoms of a central nervous system infection may also include altered mental status. Disseminated infection can also lead to cryptococcomas (fungal growths) in the lungs, skin, brain or other organs. Symptoms of C. gattii infection are estimated to begin anywhere from 2 to 14 months after exposure to the fungus. There are no formal recommendations for preventing C. gattii infection. Most people breathe in small amounts of many different types of fungal spores every day but never become sick.

**Dermatophytes (fungal skin and nail infections)**
These are fungi that cause common skin, hair, and nail infections. Skin infections caused by these fungi are also known as “ringworm” or “tinea.” Dermatophyte infections can affect the skin on almost any area of the body, such as the scalp, legs, arms, feet groin, and nails. These infections are usually itchy. Redness, scaling, cracking of the skin, or a ring-shaped rash may occur. If the infection involves the scalp or beard, hair may fall out. Infected nails become discolored, thick, and may possibly crumble. More serious infections may lead to an abscess or cellulitis. Good hygiene, such as regular hand washing, is important. People should avoid sharing hairbrushes, hats, and other articles of clothing that may come into contact with infected areas. Pets with signs of skin disease should be seen by a veterinarian. Beauty salons and barbershops should disinfect instruments with approved disinfectants after each use.

**Fungal Keratitis**
Keratitis is an inflammation of the cornea and is often caused by an infection. Bacteria, viruses, amoeba, and fungi were cause keratitis. Fungal keratitis is an inflammation of the cornea that is caused by a fungus. Types of fungi that have been known to cause fungal keratitis include Fusarium species, Aspergillus species, Candida species. Eye pain and redness, Blurred vision, Sensitivity to light, Excessive tearing or discharge. If you experience any of these symptoms, remove your contact lenses (if you wear them) and call eye doctor right away. Fungal keratitis is a very rare condition, but if left untreated, it can become serious and result in vision loss or blindness. Protective eyewear is recommended for people who are at risk for eye trauma involving organic matter, such as agricultural workers. People who wear contact
lenses should continue to follow proper lens care practices: Wash your hands with soap and water before handling contact lenses. Wear and replace your contact lenses according to the schedule prescribed by your doctor. Follow the specific lens cleaning and storage guidelines from your doctor and the solution manufacturer. Keep the contact lens case clean and replace it every 3 to 6 months. If you experience symptoms such as eye redness, pain, tearing, increased light sensitivity, blurry vision, discharge, or swelling, remove lenses from eye and consult the doctor immediately.

**Histoplasmosis**
Caused by the fungus *Histoplasma capsulatum*, which lives in the environment, often in association with large amounts of bird or bat droppings. Fever is a common symptom of histoplasmosis. Most people who are exposed to the fungus *Histoplasma* never have symptoms. Other people may have flu-like symptoms that usually go away on their own. Symptoms of histoplasmosis include Fever, Cough, Fatigue, Chills, Headache, Chest pain, Body ache. Consult the doctor immediately.

**Mucormycosis**
A rare infection caused by different fungi that belong to a group of fungi called *Mucoromycotina*. These fungi typically live in soil and in association with decaying organic matter, such as leaves, compost piles, or rotten wood. The symptoms of mucormycosis depend on where in the body the fungus is growing. Mucormycosis most commonly affects the sinuses or lungs. Symptoms of sinus infections include fever, headache, and sinus pain. Lung infections with the fungus can cause fever and cough. Skin infections can develop after the fungus enters through a break in the skin caused by surgery, burns, or trauma. A skin infection can look like blisters or ulcers, and the infected tissue may turn black. Other symptoms of a skin infection include fever and tenderness, pain, heat, excessive redness, or swelling around a wound. If the infection is not treated quickly, the fungus can spread throughout the body, and the infection is often fatal. Because these fungi are common in the environment, such as soil and decaying wood, preventing exposure is difficult. To help reduce the risk for disease, wear protective clothing, such as gloves, pants and long-sleeved shirts, if you are handling decaying wood. Disinfect cuts and scrapes after contact with soil and decaying wood and remove items that are lodged under skin, such as dirt or splinters. See the doctor if you are concerned about cuts, scrapes, or other skin injuries.

**Pneumocystis pneumonia (PCP)**
An illness caused by the fungus *Pneumocystis jirovecii*. PCP is one of the most frequent and severe opportunistic infections in people with weakened immune systems, particularly people with HIV/AIDS. The symptoms are fever, dry cough, shortness of breath, and fatigue. In people with weakened immune systems, PCP can be very serious, so it is important to see a doctor if you have these symptoms. In HIV-infected patients, PCP usually presents sub-acutely, and symptoms include a low-grade fever. In HIV-uninfected patients, symptoms of PCP tend to develop more quickly and patients typically experience a high fever. Some groups of people who are at high risk of developing PCP may need to take a medication called TMP-SMX to prevent the illness from occurring.

**Sporotrichosis**
Caused by the fungus *Sporothrix schenckii*. The fungus lives throughout the world in soil, plants, and decaying vegetation. The first symptom is usually a small painless nodules resembling an insect bite. The first nodule may appear any time from 1 to 12 weeks after exposure to the fungus. The nodule can be red, pink, or purple in color, and it usually appears on the finger, hand, or arm where the fungus has entered through a break in the skin. The nodule will eventually become larger in size and may look like an open sore or ulcer that is very slow to heal. Additional bumps or nodules may appear later near the original lesion. Most Sporothrix infections only involve the skin. To reduce the risk of sporotrichosis by wearing protective clothing such as gloves and long sleeves when handling wires, rose bushes, bales of hay, pine seedlings, or other materials that may cause minor cuts or punctures in the skin. It is also advisable to avoid skin contact with sphagnum moss.

**Hyalohyphomycosis**
Fungi from the Fusarium species may cause this infection. These fungi can enter the body through the respiratory tract, sinuses, or skin. It may cause signs and symptoms associated with a sinus infection, a urinary tract infection, a blood infection, or meningitis. These infections may occur in children with weakened immune systems. High-
dose amphotericin B or fluconazole have been used in treating hyalohyphomycosis. Malassezia species cause a common, superficial skin infection known as tinea versicolor or pityriasis versicolor. The skin of the face, torso, arms, and neck is covered with many round and scaly red areas. These areas fail to tan during the summer, but are relatively darker in the winter. The infection is most common in teenagers and young adults. Selenium sulfide lotion or shampoo is used for treatment. Ketoconazole shampoo is also effective, as are several other antifungals that are applied directly onto the affected area.

**Penicilliosis**
Children infected with HIV may be susceptible to a fungal disease called penicilliosis caused by *Penicillium marneffei*. This fungus is found in soil and decaying vegetation as well as in the air. It can cause signs and symptoms such as lung inflammation (pneumonitis) and acne-like skin lesions on the face, torso, arms, and legs. Amphotericin B or itraconazole are commonly prescribed treatments for penicilliosis.

**Phaeohyphomycosis**
Phaeohyphomycosis is a large category of fungal infections that are caused by organisms from the Bipolaris, Curvularia, Exserohilum, Pseudallescheria, and Scedosporium species. These infections often involve the skin and, in some cases, the nasal passages and sinuses. They also can infect the brain, bones, and heart (endocarditis). Superficial infections can occur in children with healthy immune defenses, while more serious infections occur in children with weakened immune systems. Treatment with medicines such as itraconazole or amphotericin B or the surgical removal of infected tissue.

**Trichosporonosis**
Children with weakened immune systems are susceptible to trichosporonosis, which can infect the lung, heart, or bloodstream. The fungus *Trichosporon beigeli*, which can produce skin lesions on the torso, face, and arms, causes trichosporonosis. Other symptoms include a cough, fever, and bloody sputum. This organism is found in soil and can enter the body through the respiratory tract, gastrointestinal system, or skin wounds. When it infects humans, it is potentially life threatening. Treatment typically involves the use of amphotericin B or fluconazole.

**Zygomycosis**
As with many other fungal infections, zygomycosis is most likely to occur in children with weakened immune systems. It may develop in children with leukemia, lymphoma, or diabetes and those who have used nonsterile bandages on wounds or cuts. Zygomycosis is caused by fungi from the Rhizopus, Mucor, Absidia, and Rhizomucor species and can cause nose and sinus infections. Affected children may have a fever, nasal congestion, and sinus discomfort. If the infection spreads, it can affect the lungs and brain and, in the worst cases, cause pneumonia, infection of the brain, seizures, paralysis, and death. Treatment includes surgical removal of the infected tissue, if possible, and use of medicines such as high-dose amphotericin B.

**Exserohilum**
Exserohilum is a common mold found in soil and on plants, especially grasses, and it thrives in warm and humid climates. Exserohilum is a very rare cause of infection in people, but it has been known to cause several different types of infections, including infection in the skin or the cornea (the clear, front part of the eye), which are typically due to skin or eye trauma.

**Other pathogenic fungi**
Exserohilum can also cause more invasive forms of infection in the sinuses, lungs, lining of the heart, and bone, which are thought to be more likely to occur in people with weak immune systems. Like other fungal infections, Exserohilum infections cannot be transmitted from person to person. Exserohilum rostratum has been identified as one of the predominant pathogens in the multistate outbreak of fungal meningitis and other fungal infections associated with contaminated steroid injections. Cladosporium is a mold that is common in the environment. Cladosporium is a very rare cause of human illness, but it has been known to cause several different types of infections, including skin, eye, sinus, and brain infections. Cladosporium has also been associated with allergies and asthma.

**Classification of antifungal agents**
Polyenes: Nystatin, Natamycin, Amphotericin B [11-14], Pimaricin, Rimicidin and Filipin
Azoles: Imidazole: Clotrimazole, Econazole, Miconazole, Oxiconazole, Sulconazole, Tioconazole, Ketoconazole, Isoconazole and Sertaconazole
Triazoles: Itraconazole [16], Fluconazole, Isavuconazole, Rosaconazole and Terconazole
Allylamines: Naftifine, Terbinafine, Tolnateate and Butenafine
Morpholine: Amorolfine
Newer antifungal agents: Voriconazole, Butoconazole, Posaconazole, Ravuconazole, Terconazole and Posaconazole.
Other antifungal: Griseofulvin, Ciclopironox, Caspofungin, Anidulafungin and Undecylenic acid
Echinocandins: Micafungin, Caspofungin
Fluoropyrimidines: Cytosine, 5-Fluorocytosine [7-9], 5-Fluoro uracil

Antifungal medicines
There are several categories of antifungal medicines. They come as creams, pessaries, shampoos, tablets, capsules and injections. Most work by damaging the cell wall of the fungus, which causes the fungal cell to die [17-21].

Antifungal creams, pessaries, or sprays (topical antifungals)
These are used to treat fungal infections of the skin and vagina. They include: clotrimazole, econazole, ketoconazole, miconazole, tioconazole, terbinafine, nystatin, amorolfine and griseofulvin.

Antifungal shampoo
A shampoo which contains ketoconazole is sometimes used to treat scalp fungal infections.

Oral preparations
Miconazole comes as an oral gel, and nystatin come as a liquid. Neither of these medicines is absorbed through the gut into the body. They are used to treat candidal infections (thrush) of the mouth and throat.
Terbinafine, itraconazole, fluconazole, griseofulvin, posaconazole, and voriconazole come as tablets, which are absorbed into the body. They are used to treat various fungal infections. Terbinafine is commonly used to treat nail infections which are usually caused by a tinea type of fungus.
Fluconazole is commonly used to treat vaginal thrush, as an alternative to using antifungal cream. It is also used to treat and prevent certain fungal infections within the body [10].

Antifungal injections
These may be used if you have a serious fungal infection within the body. Amphotericin, flucytosine, itraconazole, voriconazole, anidulafungin, caspofungin, and micafungin are medicines that are used to treat fungal infection.

CONCLUSION
In summary various types of fungal infections caused by various types of fungi. Numbers of antifungal agents are used to treat the fungal disease.

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