The Disease of Fungal Infection Its Types,Diagnosis And Treatment In Human Body

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Abstract- *Fungi are unicellular or multi-cellular eukaryotic organisms that exist in all environments worldwide. From fungi visible to the naked eye, such as mushrooms, to microscopic yeasts and molds, they exist in a multitude of forms. While most fungi do not play a significant role in human disease, there are several hundred fungi that do, resulting in fungal infection or disease. Fungal infection also know as mycosis.fungal infections typically occur in individuals who are seriously ill with recognized risk factors such as those frequently found in transplant recipients. Unfortunately, they are often diagnosed late. Fungal diseases kill more than 1.5 million and affect over a billion people. However, they are still a neglected topic by public health authorities even though most deaths from fungal diseases are avoidable. Serious fungal infections occur as a consequence of other health problems including asthma, AIDS, cancer, organ transplantation and corticosteroid therapies. Early accurate diagnosis allows antifungal therapies and helps in the treatment of fungal infection (mycosis).*

Keywords- fungal infection, mycosis, diagnosis , treatment.

I. INTRODUCTION

Fungus is about 144,000 known species of organisms of the kingdom Fungi, which includes the yeasts, rusts, smuts, mildews, molds, and mushrooms. There are also many fungus like organisms, including slime molds and oomycetes (water molds), that do not belong to kingdom Fungi but are often called fungi. Many of these fungus like organisms are included in the kingdom Chromista. Fungi are among the most widely distributed organisms on Earth and many fungi are free-living in soil or water; others form parasitic or symbiotic relationships with plants or animals, but there are some pulmonary fungal pathogens such as Aspergillus, Cryptococcus, Pneumocystis, and endemic fungi which are responsible for the fungal infection disease. Fungi thrive in warm, moist environments, fungal skin infections can often develop in sweaty or damp areas that don't get much airflow. Some examples include the feet, groin, and folds of skin. Often, these infections appear as a scaly rash or discoloration of the skin that is often itchy. Fungal skin infections are often spread through direct contact. This can include coming into contact with fungi on clothing or other items, or on a person or animal. The mortality associated with candidiasis increased Steadily until 1988, when it peaked at a rate of 0.6 per population. As a result of recent advance In the treatment of invasive candidiasis, mortality stemming From Candidemia has decreased annually since its peak.Nonetheless, systemic candidiasis remains the fourth most Common nosocomial bloodstream infection. Although The number of bloodstream infections due to C. albicans has Decreased, those due to other Candida species, particularly C. Glabrata, C. cruise, and C. parapsilosis, have increased. Candida has become the fourth leading bloodstream isolate in hospitals in the USA., Also Bacteria, viruses, parasites, fungi, prions, worms, helminthes have all been incriminated in infectious diseases, of which those caused by common viruses are the most frequent, and, until a few decades ago, those by bacteria the most feared. Fungi, like all living things, are recognized and Identified on the basis of their shapes, structures and Their behavioral properties. The disease in immune-suppressed individuals are referred to as opportunistic pathogens, which mainly involve species of Mucor, Candida, Aspergillus, and Cryptococcus. These four opportunistic fungal pathogens are reported to cause infections in covid-19 patients too. Fungi are eukaryotes; they have a Membrane surrounding their nucleus, their cells are Much larger than bacteria and their molecular Processes closely resemble those of plants and animals.However, unlike mammalian cells, fungi almost alwaysPossess a rigid cell wallcomposed of chitin products That surrounds their plasma membrane. A fungus is a vegetative organism and is definitely not A plant either because fungi do not synthesize Chlorophyll. Fungal infection having different types as follows.

1) TYPES

- On the basis of infected part of body-

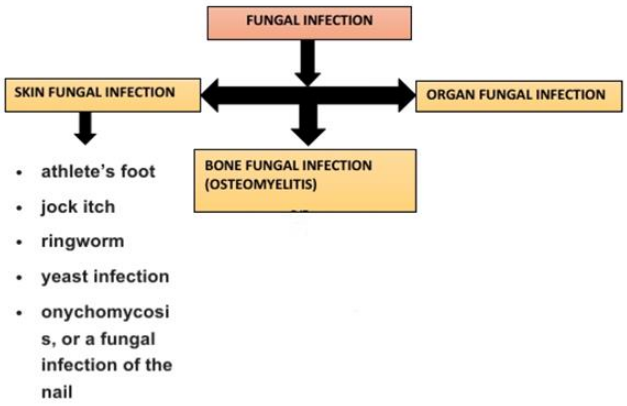

Fig. 1 Types of fungal infection.

1.1 Skin fungal infection –

The infection which is done by fungus or its pathogens on the skin in the result of redness, itchynes, patches and rashes are know as skin infection. Skin infection having some common types which are –

1.1.1 Athletes foot-

Athlete's foot is also known as tinea pedis. It's a type of fungal infection that can affect the skin on feet, as well as on hands and nails. The infection is caused by dermatophytes, a group of fungi that can thrive in the warm and humid areas between toes..

symptoms :

- Itching, or a burning, stinging sensation between toes or on the soles of feet.
- Skin that appears red, scaly, dry, or flakyCracked or blistered skin
- In some cases, the infection can also spread to other areas of body. Examples include nails, groin, or hands (tinea manuum).

Diagnosis –

This fungal infection can recognize by looking at the topical symptoms on the skin. If doctor isn't sure, a small area of the skin can be scraped off and tested for the fungus test.

Treatment-

Athlete's foot can often be treated with over-the-counter (OTC) topical antifungal medications. Some OTC medications including,

- Miconazole (Desenex)
- Terbinafine (Lamisil AT)
- Clotrimazole (Lotrimin AF)
- Butenafine (Lotrimin Ultra)
- Tolnaftate (Tinactin)

Side effects of OTC medications-

- Memory loss.
- Heart problems.
- Kidney damage.
- Liver damage.
- Internal stomach bleeding.
- Increased risk for stroke.
- Increased risk for high blood pressure.
- OTC drug addiction.

1.1.2 Jock itch-

Tinea cruris, most commonly known as jock itch, is a fungal infection of the skin.It belongs to a group of fungal skin infections called tinea. Like other tinea infections, jock itch is caused by mold-like fungi, which are known as dermatophytes. These microscopic fungi live on the skin as well as on the hair and nails. They're typically harmless, but they can multiply quickly and cause infections when they're allowed to thrive inwarm, moist areas. That's why jock itch usually develops in the skin around the groin, inner thighs, and buttocks.

Symptoms-

- Redness
- Persistent itching
- Burning sensation
- Flaking, peeling, or cracking skin
- Rash that gets worse with exercise or activity
- Changes in skin color
- Rash that doesn't improve or worsens, or spreads with over-the-counter hydrocortisone (anti-itch) cream
- Jock itch typically affects the groin and inner thighs. It may spread to the abdomen and buttocks, but the scrotum usually isn't affected.

Diagnosis-

- Doctor will likely be able to diagnose jock itch simply by performing a physical exam and inspecting the affected area of skin.

Treatment-

- Application of an antifungal cream, powder, or spray to the affected area.
- Topical medications

Econazole (Ecoza)
Oxiconazole (Oxistat)

- Oral medications

Itraconazole (Sporanox)
Fluconazole (Diflucan)

Side effects-

- Upset stomach
- Headache

1.1.3 Ringworm-

Ringworm of the scalp is not really a worm, but a fungal infection. It gets the name ringworm because the fungus makes circular marks on the skin, often with flat centers and raised borders. Also called Tinea capitis, this infection affects your scalp and hair shafts, causing small patches of itchy, scaly skin. Fungi called dermatophytes cause ringworm of the scalp. Fungi are organisms that thrive on dead tissue, such as fingernails, hair, and the outer layers of skin. Dermatophytes prefer warmth and moisture, sothey thrive on sweaty skin. Overcrowding and poor hygiene increase the spread of ringworm.

Symptoms-

- Brittle hair
- Painful scalp
- Swollen lymph nodes
- Low-grade fever
- In more severe cases, you may develop crusty swellings called kerion that drain pus. These can lead to permanent bald spots and scarring.
- The most common symptom of ringworm is itchy patches on the scalp. Sections of hair may break off near the scalp, leaving scaly, red areas or bald spots.

Treatment-

- Antifungal medication-

The leading antifungal medications for ringworm are griseofulvin (Grifulvin V, Gris-PEG) and terbinafine hydrochloride

Side effects-

Side effects of griseofulvin include:

- Sun sensitivity
- Vomiting
- Fatigue
- Faintness
- Dizziness
- Allergic reactions in people who are also allergic to penicillin
- Headache
- Rash
- Hives

Terbinafine hydrochloride include:

- Stomach pain
- Itching
- Rash
- Hives
- Loss of taste or change in taste
- Allergic reaction
- Headache
- Fever
- Liver problems, in rare cases

1.1.4 Yeast infection-

Candida albicans is a type of fungus that can infect skin, mouth, gastrointestinal tract, urinary tract, or genitals. It's normal for small amounts of candida albicans to be present on skin and in our body. But when these fungi multiply too much, they can cause an infection known as a yeast infection.

Symptoms-

- If you get a yeast infection in your throat or mouth, it's called oral thrush. Thrush causes white patches to form in mouth and throat. People who undergo prolonged antibiotic therapy often develop this type of infection.
- In women, vaginal yeast infections are relatively common. They can causePain ,itchiness, clumpydischarge, swelling, redness.

Diagnosis-

- This might include gathering information about past vaginal infections or sexually transmitted infections.
- Performs a pelvic exam. Doctor examines your external genitals for signs of infection. Next, doctor places an instrument (speculum) into vagina to hold the vaginal walls open to examine the vagina and cervix — the lower, narrower part of uterus.
- Test of vaginal secretions. Doctor may send a sample of vaginal fluid for testing to determine the type of fungus causing the yeast infection. Identifying the fungus can help your doctor prescribe more effective treatment for recurrent yeast infections.

Treatment-

- Short-course vaginal therapy-Taking an antifungal medication for three to seven days will usually clear a yeast infection. Antifungal medications - which are available as creams, ointments, tablets and suppositories — include miconazole (Monistat) and terconazole. Some of these medications are available over-the-counter and others by prescription only.
- Single-dose oral medication.doctor might prescribe a one-time, single oral dose of fluconazole (Diflucan). Oral medication isn't recommended inpregnancy.
- Long-course vaginal therapy. Doctor might prescribe an antifungal medication taken daily for up to two weeks, followed by once a week for six months.
- Multidose oral medication. Doctor might prescribe two or three doses of an antifungal medication to be taken by mouth instead of vaginal therapy. However, this therapy isn't recommended for pregnant women.
- Azole resistant therapy. Doctor might recommend boric acid, a capsule inserted intovagina. This medication may be fatal if taken orally and is used only to treat candida fungus that is resistant to the usual antifungal agents.

Side effects-

- Headache, stomach upset, diarrhea, rash, itch, and loss of taste.

1.1.4 Nail fungal infection-

Its formal name is onychomycosis, and it's a lot like athlete's foot. But instead of affecting the skin on the bottom of feet or between toes, it invades nails.

There are four main kinds of fungal nail infection. Each looks slightly different:

- Distal or lateral subungual onychomycosis. This is the most common kind. It results from a fungus called a dermatophyte. This affects on fingernails or toenails. It starts in the nail bed, underneath the nail. It looks a yellowish colored area that spreads from the edges of the nail to the center, and places where it comes apart from the nail bed.
- White superficial onychomycosis. This is less common and only affects the nail surface, mainly on toenails. It starts as white spots, which become powdery and cause the nail to crumble.
- Proximal subungual onychomycosis. This appears first as white spots in the center of the nail bed at the cuticle. They move outward as the finger or toenail grows. It's rare and usually affects people who have immune system problems, like HIV infection.
- Candida onychomycosis. Yeast causes this infection that usually affects fingernails. The area around the nails is often swollen and inflamed, and the nails may come off entirely. It tends to happen to nails that have been damaged by an injury or another infection.

Symptoms-

- At first, a white or yellow spot under the nail. Over time, this spreads and can turn whole nail white, yellow, green, or black.
- The nail may thicken and could be hard to trim.
- It may start to curl up or down or loosen from the nail bed.
- Nail become brittle and crumble.
- Nail may become misshapen.
- Nail may do a bad smell.

Treatment-

- An oral antifungal medication, such as:
- Terbinafine (Lamisil)
- Itraconazole (Sporanox)
- Fluconazole (Diflucan)
- Griseofulvin (Gris-PEG)

1.2 Bone fungal infection

Bone fungal infection also called as osteomyelitis. Osteomyelitis is an infection of the bone that can affect both adults and children. If left untreated, it can lead to bone tissue death over time. Osteomyelitis is a bacterial, or fungal, infection of the bone. Osteomyelitis affects about 2 out of every 10,000 people. If left untreated, the infection can become chronic and cause a loss of blood supply to the

affected bone. When this happens, it can lead to the eventual death of the bone tissue. In adults, osteomyelitis often affects the vertebrae and the pelvis. In children, osteomyelitis usually affects the adjacent ends of long bones. Long bones (bones in the arms or legs) are large, dense bones that provide strength, structure and mobility. They include the femur and tibia in the legs and the humerus and radius in the arms. Osteomyelitis is not more common in a particular race or gender. However, some people are more at risk for developing the disease, including:

- People with diabetes.
- Patients receiving hemodialysis.
- People with weakened immune systems.
- People with sickle cell disease.
- Intravenous drug abusers.
- The elderly.

Causes-

- An open injury to the bone, such as an open fracture with the bone ends coming out through the skin.
- A minor trauma, which can lead to a blood clot around the bone and then a secondary infection from seeding of bacteria.
- Bacteria in the bloodstream (bacteremia), which is deposited in a focal (localized) area of the bone. This bacterial site in the bone then grows, resulting in destruction of the bone. However, new bone often forms around the site.
- A chronic open wound or soft tissue infection can eventually extend down to the bone surface, leading to a direct bone infection

Symptoms-

- Pain and/or tenderness in the infected area.
- Swelling, redness and warmth in the infected area.
- Fever.
- Nausea, secondarily from being ill with infection.
- General discomfort, uneasiness, or ill feeling.
- Drainage of pus (thick yellow fluid) through the skin.

Diagnosis-

- Radiographs (X-Rays): These tests can show abnormalities of the bone. The abnormalities can include a focal decrease in density, which can suggest bone destruction from bacteria. It can also demonstrate an area where infected bone can be trapped by a bacterial infection.
- Magnetic Resonance Imaging (MRI): This imaging examination can show any fluid in the bone with greater sensitivity and precision. It is a helpful tool to see how far the infection has spread, if present.
- Blood tests: When testing the blood, measurements are taken to confirm an infection: a CBC (complete blood count), which will show if there is an increased white blood cell count; an ESR (erythrocyte sedimentation rate); and/or CRP (C-reactive protein) in the bloodstream, which detects and measures inflammation in the body.
- Blood culture: A blood culture is a test used to detect bacteria that has escaped into the bloodstream. A sample of blood is taken and then placed into an environment that will support the growth of bacteria. By allowing the bacteria to grow, the infectious agent can then be identified and tested against different antibiotics in hopes of finding the most effective treatment.
- Needle aspiration: During this test, a needle is used to remove a sample of fluid and cells from the vertebral space, or bony area. It is then sent to the lab to be evaluated by allowing the infectious agent to grow on media.
- Biopsy: A biopsy (tissue sample) of the infected bone may be taken and tested for signs of an invading organism.
- Bone scan: During this test, a small amount of Technetium-99 pyrophosphate, a radioactive material, is injected intravenously into the body. If the bone tissue is healthy, the material will spread in a uniform fashion. However, a tumor or infection in the bone will absorb the material and show an increased concentration of the radioactive material, which can be seen with a special camera that produces the images on a computer screen. The scan can help your doctor detect these abnormalities in their early stages, when X-ray findings may only show normal findings.

Treatment-

The objective of treating osteomyelitis is to eliminate the infection and prevent the development of chronic infection. Chronic osteomyelitis can lead to permanent deformity, possible fracture, and chronic problems, so it is important to treat the disease as soon as possible.

- Drainage: If there is an open wound or abscess, it may be drained through a procedure called needle aspiration. In this procedure, a needle is inserted into the infected area and the fluid is withdrawn. For culturing to identify the bacteria, deep aspiration is preferred over often-unreliable surface swabs. Most pockets of infected fluid collections (pus pocket or abscess) are drained by open surgical

procedures. The reason for this is that antibiotics are ineffective at reaching pockets of infected fluid as they have no blood supply.

- Antibiotic medications: Prescribing antibiotics is the first step in treating osteomyelitis. Antibiotics help the body get rid of bacteria in the bloodstream that may otherwise re-infect the bone. The dosage and type of antibiotic prescribed depends on the type of bacteria present and the extent of infection. While antibiotics are often given intravenously, some are also very effective when given in an oral dosage. It is important to first identify the offending organism through blood cultures, aspiration, and biopsy so that the organism is not masked by an initial inappropriate dose of antibiotics. The preference is to first make attempts to do procedures (aspiration or bone biopsy) to identify the organisms prior to starting antibiotics.

Surgery: Most well-established bone infections are managed through open surgical procedures during which the destroyed bone is scraped out. In the case of spinal abscesses, surgery is not performed unless there is compression of the spinal cord or nerve roots. Instead, patients with spinal osteomyelitis are given intravenous antibiotics. After surgery, antibiotics against the specific bacteria involved in the infection are then intensively administered during the hospital stay and for many weeks afterward.

1) ORGAN FUNGAL INFECTION

Fungal infections in solid organ transplant recipients continue to be a significant cause of morbidity and mortality. Candida spp. and Aspergillus spp. account for most invasive fungal infections. The incidence of fungal infection varies with type of solid organ transplant. Liver transplant recipients have highest reported incidence of candida infections while lung transplant recipients have highest rate of Aspergillus infections. Candida albicans remains the most common species causing infection, but a shift towards non-albicans species has been observed. C. glabrata is the second most common etiologic agent.

Diagnosis-

If doctors suspect a primary fungal infection, they ask people questions that can help with the diagnosis, such as the following:Where they have traveled and lived to determine whether they may have been exposed to certain fungi, perhaps years previouslyWhether they are taking any drugs that can suppress the immune systemWhether they have a disorder than weakens the immune system. Doctors then take a sample to be grown in a laboratory (cultured) and examined under a microscope. The sample may be sputum or blood, but, occasionally, doctors must take a sample from the lungs. To take a sample from the lungs, doctors insert a flexible viewing tube (a bronchoscope) through the mouth and into the airways. Fluid is squirted through the tube, then suctioned back into the tube, bringing cells and any fungi (or other microorganisms) with it. Sometimes biopsy or surgery is necessary to obtain a sample

Treatment-

The principles for treatment of cryptococcal infections in solid organ transplant recipients are derived from the experience with HIV positive patients. An amphotericin B product together with 5-flucytosine for a 2-week induction is the treatment of choice for patients with cryptococcal meningitis or disseminated disease. Amphotericin B deoxycholate can be substituted with lipid preparation of amphotericin with dosing ranging from 3–6 mg/kg/day. Since baseline renal insufficiency is common in transplant recipients and they are often receiving other nephrotoxic drugs, lipid formulations of amphotericin B are generally better tolerated. If at the end of 2 weeks clinical and microbiological response is observed, therapy can be continued with fluconazole for a minimum of 10 weeks 85. Selected patients with isolated pulmonary cryptococcosis and mild to moderate symptoms can be treated with fluconazole monotherapy.

Some pathogens and characteristics of disease.

- OPPORTUNISTIC PATHOGENS-

1. Candidiasis Candida SPP

Acute disseminated: fever, chills, polymyalgia, polyarthralgia, not tender Pinkish skin lesions, retinal exudates. Chronic: complaints of the organ involved.

2. Aspergillus spp

Unremitting fever and pulmonary infiltrates during antibiotic therapy. Chest Pain, pleural rub, pleural effusion, hemoptysis. Halo and air crescent sign on Chest radiograph and CT scan.Clinical and radiologic sinusitis.

3. Cryptococcus neoformans

Flu-like symptoms; skin lesions, headache without meningismus.

4. Rhizopus spp,Absidia spp ,Mucor spp

Like aspergillosis, more outspoken rhino-cerebral form with serosanguinous Nasal discharge.

5. Malassezia furfur, Trichosporon spp, Fusarium spp, Pseudallescheria, Scedosporium spp, Alternaria spp

Catheter-associated; pneumoniaSkin and lung lesions Often positive blood cultures. Skin lesions, severe myalgia. Abscess formation With symptoms depending on organ involved.Like aspergillosis; wound infections.

- ENDEMIC PATHOGENS-

1. Blastomyces dermatitidis

Ulcerative lesions; skin, urogenital tract Central nervous system

2. Histoplasma capsulatum

Pulmonary infiltrates; mucocutaneous ulcers Hepatosplenomegaly

3. Coccidioidis immitis

Pulmonary infection. Dissemination with osteomyelitis, arthritis, meningitis.

4. Paracoccidioidis brasiliensis

Pulmonary infection. Dissemination to skin, mucosa and lymphnodes.

5. Penicillium marneffei

Skin and subcutaneous laesions, lung, lymphadenitis, splenomegaly.

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