

FUNGAL INFECTIONS

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Fungi are quite distinct from bacteria in size, cellular structure and chemical composition. These organisms are considered “higher beings” compared with bacteria. They may contain one nucleus or a multiple nuclei surrounded by a specific cell wall. However, their life cycle varies from simple to complex and they may reproduce by both asexual and sexual reproduction. Because of the latter feature, fungi are considered to be much more complex than bacteria.

Fungi can be divided rather simply into yeasts and molds based on their physical appearance. Yeast-like fungi are typically round or oval, generally form smooth flat colonies when grown in the laboratory, and reproduce by buds projecting from the mother cell. Molds are composed of tubular structures called hyphae and grow by branching thus producing extensions from the mother cell.

Fungi, though simple organisms, are extremely adaptable to diverse environments. Their chief function is to recycle organic debris. As a result, they may live on wood, vegetation, fats, oils, asphalt, waxes, bones, and so forth. They are also able to adapt and proliferate in abnormal environments such as mammalian tissue. In particular, yeasts readily adapt to the human environment and organisms such as *Candida* species are normal inhabitants of the skin, gastrointestinal tract, female genital tract and urine. In contrast, molds produce conidia (spores) that are easily carried by wind and water.

Overall, the most commonly encountered fungal infections are those that affect the skin. Approximately 1-2% of the world’s population is affected by dermatophytoses (superficial fungal infections of the skin). The organisms causing these infections are commonly found on the skin and produce non-life threatening skin rashes. As a result, topical therapy with creams or lotions are most commonly used to treat this condition.

Of the pathogenic fungi that cause invasive fungal infection, that is, infections that may invade into internal organs or other tissues, *Candida* species is by far the most common. *Candida* exists in a yeast form that is a normal inhabitant of the skin, digestive tract, and genitourinary tract. As a result, it produces a diverse array of infections. The spectrum of infections include: superficial skin infections in moist areas where the skin may be macerated (arm pits or groin); vaginal infections; infections of the mouth and throat as well as the esophagus; and invasion into organs such as the lungs, liver and bloodstream. Although superficial *Candida* infections of the skin are fairly common, invasion into organs is unusual. The latter infections are usually not seen unless the body’s defense against invasive *Candida* infections is weakened. This defense is a special type of white blood cell called the neutrophil. Thus, invasive *Candida* infections into the lungs, liver, and gastrointestinal



tract only occur when neutrophil counts are extremely low. In contrast, infection of the bloodstream is more common. This infection may arise when *Candida* organisms that are naturally found on the skin gain access to the bloodstream. This may occur when there are breaches in the skin barrier such as vascular access devices that provide a portal of entry. On the other hand, lymphocytes, another type of white blood cell, provide a necessary immunity against *Candida* infection of the mouth, throat, esophagus and vagina. In individuals who lack adequate lymphocyte function these latter infections are quite common. *Candida* infections of the skin may be treated with topical therapy whereas infections of the mouth, throat, esophagus and organs require systemic therapy that is administered orally or intravenously.

Aspergillus species may also produce invasive fungal infection, but do so less commonly than *Candida* species. This type of fungus may produce allergic reactions and fungus balls in the lung, invasion of lung tissue and infection throughout the body. Infection is produced by inhalation of conidia into the lungs with the initiation of infection in that organ. From the lungs the infection may disseminate throughout the body. Once again, the neutrophil is the main defense against this fungus. Lack of neutrophil function as a result of very low neutrophil counts or inadequate function produces an environment favorable for *Aspergillus*

infection. Therapy for these infections involves the administration of systemic antifungal therapy either in oral or intravenous forms.

In addition, there are some fungi that produce infection after heavy exposure. *Cryptococcus*, *Histoplasma*, *Coccidioides*, and *Blastomyces* can infect humans after heavy exposure. These fungi are associated with certain environmental conditions. For example, *Cryptococcus* is found in pigeon droppings or on certain types of trees and inhalation of large amounts of the fungus may produce infection in the lungs with spread of the organisms throughout the body. *Histoplasma* is found in the soil in certain areas of North America and may incite infection when the organisms are dispersed in the air such as during construction activities. Also, outbreaks of *Coccidioides* have occurred after earthquakes when these organisms that reside in soil have been spread via clouds of dust. Therapy for all of the aforementioned fungal infections requires either oral or intravenous antifungal medications.

Fungi are a diverse group of microorganisms that have adapted themselves to live in a variety of environments. These environments vary from the human body to areas in nature. They produce diverse human infections ranging from superficial skin infections to internal organ invasion in the body. These infections usually occur as a result of a decrease in natural human defenses or opportunistic heavy



exposure to the fungus. Therapies for these infections vary according to the type of infection. Superficial infections are often treated with topical agents whereas organ involvement must be treated with systemic therapy.

Selected References

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