Introduction to Mycology

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 Mycology is the study of fungi and fungi are very diverse but generally classified as either yeast or mold. Fungi are eukaryotic so they have a true nucleus and mitochondria. Like plants fungi have a cell wall but it is made of chitin instead of cellulose. They do not possess chlorophyll so they must absorb energy from the environment. They do best with a neutral pH and need moisture to grow. • Yeasts and molds have different structural and reproductive characteristics

Yeasts

 Yeasts are unicellular, nucleated rounded fungi; reproduce by a process called budding with production of a blastoconidium or daughter cell. Yeast produce creamy bacterialike colony without aerial hyphae.

Molds

 Molds are multicellular, filamentous fungi that have a fuzzy or woolly appearance due to the mycelium. Mycelium is made up of many long strands of tube-like structures called hyphae which may be aerial or vegetative. Molds are often identified by microscopic observation so the details of their structures are of note. Hyphae may be septate or sparsely septate, indicating how often there is a cross-wall between cells. Hyphae are often either hyaline, lightly pigmented, or dematiaceous or darkly pigmented due to melanin in the cell wall.

Molds

- Molds may reproduce sexually or asexually.
 - Asexual reproduction results in the formation of conidia after mitosis by budding from the conidiogenous cells (specialized cells). Asexual reproduction can also be carried out by forming arthroconidia by fragmentation of fertile hyphae. In the clinical lab most molds are identified on the basis of the structures formed as a result of asexual reproduction.
 - Sexual reproduction requires the joining of two compatible nuclei followed by meiosis.

Molds

- Most clinically significant molds are found in four groups of fungi.
 - Zygomycota: Zygomycetes are rapidly growing organisms normally found in the soil that become opportunistic pathogens. May asexually reproduce creating spores in the sporangium (sproangiospores) or sexually creating zygospores. Common examples include: *Mucor, Rizopus, and Absidia.*
 - Ascomycota: Characterized by the production of sexual spores known as ascospores but usually identified by asexual structures. Common examples include: *Microsporum spp. Trichophyton spp. and Pseudallescheria boydii.*
 - Basidiomycota: Only major pathogen is *Filobasidiella neoformans,* the perfect (sexual) form of *Cryptococcus neoformans var. neoformans.*
 - Fungi Imperfecti: Contains the largest number of organisms that are etiologic agents of infections. Organisms are placed in this group when no mode of sexual reproduction has been identified.

 Dimorphic fungi are those that can exist in two forms. The yeast or tissue state is seen in vivo (life, in patient) or when grown at 37°C. The mold phase is seen when the organism is grown at room temperature or 25°C. Dimorphic species include Blastomyces dermatitidis, Coccidiodes immitis, Histoplasma capsulatum var. capsulatum, Paracoccidioides brasiliensis, Sporothrix schenckii and Penicillium marneffei.

Disease states, primarily Mycosis, the growth of a fungus on or in the body

- Superficial mycoses are infections confined to the outermost layer of skin or hair. Characteristics include discoloration or depigmentation and scaling of the skin. Fungal species include: *Malassezia furfur, Piedria hortae and Trichosporon beiglii*.
- Cutaneous mycoses are infections affecting the keratinized layer of skin, hair or nails. Signs include itching, scaling, or ring-like patches or skin. Fungal genera include: *Trichophyton, Epidermophyton and Microsporum* organisms.
- Subcutaneous mycoses involve deeper skin layers including muscle and connective tissue. Characteristics include progressive, non-healing ulcers and presence of draining tracts. Tropical areas have species *Phialophora spp. and Cladosporium spp. Sporothrix schenckii* may present in a cutaneous form and disseminate into a systemic infection.
- Systemic mycoses are those infections that affect internal organs or deep tissues of the body. The initial site is often the lung where the organism may disseminate via the circulatory system. General symptoms are fever and fatigue or chronic cough and chest pain. Diamorphic species include: *Histoplasma, Coccidioides and Bastomyces.*

Disease states, primarily Mycosis, the growth of a fungus on or in the body

- Opportunistic fungal infections caused by saprobes are becoming more and more common as we have a more diverse immunocompromised population. There are upwards of 24 different species in this category a few examples are: Alternaria spp., Aspergillus spp., Curvularia spp., Fusarium spp., Mucor spp., Penicillium spp., Syncephalastrum spp., and Ulocladium spp.
- Clinically significant yeasts are differentiated by colony appearance, microscopic stains and carbohydrate assimilation. The most clinically significant yeasts are *Candida albicans and Cryptococcus neoformans.*
- Allergic reactions to specific fungal antigens
- Production and action of fungal exotoxins

Fungi serve both beneficial and harmful purposes in our environment.

- Many have been identified as classic pathogens, causing infections when they come in contact with people. Others are only environmental saprobes that can be opportunistic pathogens in that they cause disease in immunocompromised individuals.
- Yeast is used in the preparation of foods like yogurt, bread and cheese.
- Molds are used in the production of cheeses and other foods and also serve an antimicrobial purpose. Molds can also have a negative impact on our food industry.