Returning back to our topic on human mycosis or medical mycology, we have in the first part to explain the difference between molds, filamentous fungi and budding yeast.

Budding yeast is of two types; non-pathogenic and pathogenic and usually reproduced by budding while other means produce what we call Pseudohyphae filament like structure that is of more importance and related to certain types of yeast called Candida.

Dermatophytosis /Superficial Mycosis/ Cutaneous Mycosis

We have started with the second part which is related to infections caused by filamentous fungi. First group of these filamentous fungi is widely associated with the human skin, hair and nails which is the causative agent of the superficial mycosis. The term superficial mycosis is due to the fact that these filamentous fungi can’t penetrate the subcutaneous tissue, can’t reach blood stream and can’t produce any form of sepsis. They only attack the superficial dead keratinized layers of our body where they attach and grow producing a variety of infections (it’s only related to superficial dead cutaneous tissues). The first name that was used at the beginning of the 19th century is the term “Ringworm” but this term has been later replaced by another term called “Tinea” (which is still used in medical literature) but now it’s more common to read the terms dermatophytosis or cutaneous mycosis or superficial mycosis in relation to diseases of hair and nails.

Tinea Versicolor / Pityriasis Versicolor

The first type of skin infection related to yeast; a type of yeast which is considered part of our normal flora but under certain conditions might produce certain types of skin infections. These skin infections might be of two types; it might only be related to changing the color of the skin producing a spot or it might produces erythematic lesions if there is more allergic reaction or manipulation with instruments or nails (and this requires treatment). Whereas *pedis are usually self-limited and might disappear within 1-2 weeks.
This type of disease is called Tinea Versicolor or a new term is used which is *Pityriasis Versicolor* (Versicolor is related to the change in skin color not more or less) and it’s only related to a form of allergic reaction and often under certain conditions (especially amoxicillins) this type of infection might be bound on any part of our skin (mostly the parts exposed like hair, face, neck, hands etc.).

*Tinea Capitis*

The second type of infection is related to hair and is called *Tinea Capitis* which states an infection of the hair with a filamentous fungi (not a yeast type). This filamentous fungi in fact can only produce superficial infection on the projected hair shaft and might also affect the hair follicles producing severe inflammatory reactions that often results on the damage of hair follicles and permanent hair loss. This type of Tinea Capitis is found mainly in children under the age of 14. Adults (including young adults) rarely develop such types of infection related to hair due to the production of sexual hormones.

In our country there are still cases and even outbreaks associated with this type of diseases due to the fact that the spores of these fungi (which are called Trichophyton and Microsporium) can be easily spread by contact with infected hair or dust particles and thus might infect another person. Generally, the health condition of hair is important in prevention of the spread of the disease but it’s not self-limited. Any infection related to the hair should be treated with a type of antifungal drug like Casbofungin which is the drug of choice and has usually eradicated the organism.

*Tinea Unguium & Tinea Pedis*

A third type of infection is related to the nails and called *Tinea Unguium*. It often affects the tip of the nails in the beginning then it might extend to the folds of the nail (to clarify: it's usually seen first as white patches or pits on the surface or around the edges of the nails, followed by infection beneath the nail plate) and it might be associated with bacterial infection. Tinea Unguium is the scientific term from the Latin language and is usually related to hands and nails.

In relation to feet nails, the infection is often not only related to nails alone, but it’s associated with the interspaces between the fingers and will produce an infection known as *Tinea Pedis* which is very common (almost 30% to 50% of our country’s population are expected to be infected with Tinea Pedis). This type of infection is not severe. However, it might get so severe in certain cases especially if there is certain genetic factors or immunological factors, so still there is no clues why some people have more lesions or more severe form of lesions in the interspaces of the fingers. Generally, Tinea affecting nails (caused by filamentous fungi, mainly Trichophyton species and
Microsporium species) often can’t be easily eliminated even when using an antifungal drug. The only way is usually removing the nails by surgical means in order to get rid of the infection.

**Causative agents of Dermatophytes**

The causative agent of Dermatophytes in general can be one of the three; the Epidermophyton, the Trichophyton and the Microsporium (these are the three genera usually considered to contain dermatophytic species). Each one of them is composed of many species. Both Trichophyton and Microsporium infect hair, nails and skin exactly with the same clinical features so that we can’t identify clinically if this is caused by Trichophyton or Microsporium. The only way to demonstrate is to notice the presence of Micro or Macro Conidia in relation to each one and to notice the color of growth (green, yellow or brown etc.). This requires certain experience in order to know the morphological structure and color, which means that there is no way in clinical ground (clinically) to distinguish between these. The third genus; Epidermophyton mainly affects skin and can rarely affect hair or nails. Epidermophyton species is difficult to grow and more difficult to be identified in laboratories.

**Candida**

The previous was enough about superficial mycosis and we will now move to another important type of yeast which is part of our normal flora and is called *Candida*.

(To clarify: candida is any of yeastlike imperfect fungi of the genus Candida that are normally present on the skin and in the mucous membranes of the mouth, intestinal tract, and vagina, and that may become pathogenic especially Candida albicans, the causative agent of thrush).

**Candidiasis/ Candidiosis**

Diseases related to candida can be called *Candidiasis* or *Candidiosis* (Candidiasis is more used in the American literature whereas Candidiosis is used in the British one but both indicate the presence of a disease caused by a type of Candida).

There are almost twelve species of candida which can be adapted and associated with our human body but the majority of infections are related to five species which are usually isolated from clinical specimens. The first one which is very common and associated with almost (50%-70%) of all types of Candidiosis in humans is called *Candida Albicans* (albicans is related to the white color of candida). Less common other species are Candida *glabrata*, Candida *Tropicalis* and Candida *Krusei*. 


During the last 20 years, there was a change in the incidence of these candida species related to the use of antifungal drug called Fluconazol. Fluconazol has been widely used in the last 20 years for treatment of vaginal discharge and for treatment of all types of candidiasis related for example to the oral cavity. This has resulted in shifting of incidence or increasing the incidence of candida glabrata and Krusei usually on the prevalence of candida albicans due to the fact that candida glabrata and candida Krusei have developed resistant to Fluconazol. So in the recent years we recognized resistant candidiasis which can’t respond to fluconazol in association with many clinical infections and this is an example for the change in ecology of infection related to the wide usage of an antifungal drug exactly as has been observed in relation to developing of resistant in staph. and other types of organisms.

All types of candida can be found in few numbers in the oral and intestinal cavities in association with the genital tract (part of normal body flora in mouth, vagina, skin, intestine and urinary tract).

Under normal health conditions, these types of candida can’t produce any type of infection. Any change in the oral, intestinal or vaginal flora due to the use of antimicrobial drugs or in relation to a change in the immunity status of any person, will usually increase the number of candida and it might be associated with an infection related to the mucosal part of our body and might produce localized inflammatory reaction. Therefore, candida infection is an opportunistic infection which means that under certain conditions it will be activated and will be associated with developing of infection.

Most infections in humans are considered as endogenous infections (not acquired from outside, they’re already there) but it can be exogenous in relation to hospitalized patients if there’s any invasive technique using special devices (catheters or prosthetic devices) which might be contaminated with our hands or with the environment and might produce infection.

In general, there are factors which contribute for developing of candidiasis in human beings. First; wide using of antimicrobial drugs especially the wide spectrum. Second; presence of immunocompromised condition. Third; exposing for radiation and exposing for toxic drug. All these factors together contribute for developing of candidiasis. The exogenous source again is mainly in hospitalized patients but in community the infection is often related to the presence of normal flora of candida.
Back to our topic, in relation to candidiasis, **oral candidiasis** as an example is very common in infants and young children and it’s often due to the use of an antimicrobial drug. In order to know if this candida is a true pathogen or not, we have to demonstrate (demonstration budding yeast: are usually spherical or oval yeast cells associated with small daughter cells or buds, should produce elongation. This elongation can be demonstrated in gram stain and this is known as Pseudohyphae structure (pseudo filaments) and if you look exactly here you recognize between the two cells the presence of small oval cells, these small oval cells are usually known as Blastospores. If these small spores found on the tip of the filament then they are called Chlamydospores and this feature (the presence of blastospores or chlamydospores in association with these candida is often related to candida albicans not to other candida types where they usually produce filaments without the presence of these blastospores and chlamydospores and this can also be demonstrated in vitro by using of a special culture media like \*chromium agar so this is an example of the identification of pathogenic candida from non-pathogenic candida in the laboratory as well as distinguishing between candida albicans and candida Krusei etc.

In addition, we have a special culture medium in the laboratory called chromo agar candida which can identify the different four to five types of candida but not in adults as they require biochemical tests.

**Candida Thrush**

Candida thrush, which is found mostly in children but can also be found in adults, means there is often a developing of large numbers of numerous filaments usually on the surface of the floor of the mouth as well as the tongue. This cover is usually whitish and you have not to try to remove it by using any instrument because if you try to remove this cover from the patient's tongue, for example, he might bleed because the filaments are usually inside the subcutaneous tissue of the tongue and they shouldn’t be removed. Instead, using an antifungal drug and stopping the antimicrobial drug for two to three days will relieve the patient and he might not suffer from the presence of candida thrush.

Candida thrush in children means that the child can’t eat and can only difficultly drink so it’s a serious type of illness. Under certain conditions, if the patient is not treated with an antifungal drug, the thrush might spread to pharynx and larynx and this can be very serious especially in a patient with AIDS. Candida is usually fatal resulting in severe inflammatory reactions within the larynx and reach the lung causing suffocation and death of the patient. AIDS patients' usually don’t die from the virus but from the
complications associated with the infection especially with candidiasis and other types of diseases.

Clinical Features

Back to clinical features (the secondary) in association with candidiasis. The most common in children is the oral mucosa infection which is in form of candida thrush.

The second might be related (in adults usually) to other type of diseases especially if they are immunocompromised, it might associate with the throat, pharynx, lungs candidasis and might reach the blood stream causing candida sepsis.

In very rare cases it may produce meningitis and only in immunocompromised conditions which usually have malignancy and are immunosuppressed.

A more common type of candidiasis is actually recognized in women especially in association with pregnancy. There is no pregnant woman didn’t develop vaginal discharge during pregnancy due to the increased number of candida in mucosa following the change in the hormones of the pregnant woman and this results mostly in irritation, burning during urination and discharge of fluids; mostly sticky fluids and whitish containing a large number of candida with the epithelial cells (this is called Candidemia which indicates the presence of the fungi Candida in the blood) and this requires treatment.

Sexual contact might also be associated with candidiasis in certain percentage of the married women. So vaginal candidiasis is a very common feature associated with pregnancy, even associated with antibiotic treatment and also associated with other type of underlying disease.

Cryptococcus Neoformans

In other type of yeast, we have one important type of disease called Cryptococcus Neoformans which is the only encapsulated important pathogen and is also again associated with lower respiratory tract infection. Severe form of it might be associated with even chronic lung disease which later might disseminate to the blood stream, reach the meninges, produce chronic meningitis and brain abscess.

Cryptococcus Neoformans is a highly fatal organism especially in immunocompromised conditions. If the organism reaches the blood stream and the meninges then there is a few chance for curing, it’s often very difficult and very dangerous and often only
associated with presence of underlying disease especially malignancy or immunosuppressed conditions. It can’t produce infection in healthy person. Cryptococcus Neoformans is excreted in the feces of birds especially pigeons. Therefore, any person who is immune deficient must not have contact with these birds as he might get easily infected with the Cryptococcus Neoformans and it will first produce a localized infection in sinuses and later in the lung and produce severe acute or chronic diseases.

**Mold Infection: Aspergillosis**

The other types of filamentous fungi, which again might be associated with lung infection or localized infections in the sinuses, are wide and many but we’ll concentrate on one important species which is associated with at least (70%-80%) of all types of filamentous infections in human's body especially in relation to what we call a form of localized infection in the respiratory tract. Mold infection is caused by *Aspergillus*.

The *Aspergillus* is a very common type of fungi found in the environment. All of us are always exposed for the spores of the aspergillus so it’s not easy to prevent the inhalation of these spores but healthy people usually manage to prevent the attachment of the spores to the mucosa of the respiratory tract and prevent the developing of spores into filaments to produce localized infection. On the other hand, in any person suffering a damage in the respiratory tract or is an immunocompromised, these spores might manage to lodge and later to produce filaments. These filaments usually produce a less mycelium inside the infected tissue and produce damage in it.

We have three aspergillus species that are of great importance, they are found in nature and often associated with human infection. The very common one is *Aspergillus Flavus*, which in addition to produce filaments within the infected tissue of the lung and sinuses, or other internal parts of the body, this fungus is the only fungus which produces very potent toxins, these toxins are known as *flava toxins* and *afla toxins*.

*Afla toxins* are very commonly associated with many types of food articles for example it might contaminate rice, beans and even milk powder might be affected by the aspergillus producing a form of afla toxins which might later produce a form of mycotoxic effect. Mycotoxic effect is a case of intoxication due to absorption of this toxin. The severe effects of this toxin on the liver produces severe cirrhosis and death. There’s actually an outbreak of mycotoxins related to consumption of certain types of food especially rice which is sometimes not well boiled or in relation to other types of food especially dry beans which can be easily affected. In our country they control a lot
of types of food like milk and dairy products for the presence of afla toxins in order to prevent the developing of afla toxins syndrome.

Afla toxins in nanogram are enough to kill a person, so be careful if you have peanuts in your homes because peanuts are very easily infected with the aspergillus flavus (if there is any moist). You can demonstrate this feature in your home by placing some peanuts in a dish and putting only one or two drops of water, leave it for few days and you’ll later notice the presence of a white color, this white color will later change to yellow, brown or black and this denotes the developing of the aspergillus. If you try to taste these peanuts you will taste bitterness and this indicates the beginning of developing a substance which is called afla toxin. One peanut, of course, will not be associated with a severe toxic effect but eating 50 grams or more can be fatal and this is very easy to be recognized in your homes.

Aspergillus is not only important in relation to immunocompromised patients, as it might develop aspergillosis or develop what we call a nest of filaments inside the lung called fungal mold within the lung. This produces damage in the lung and requires surgical treatment or the patient will die from the following complications as the lung tissue has been damaged.

Aspergillus might produce allergic reaction; a form of asthma develops in certain percentage of the population if they are exposed repeatedly for the antigen of aspergillus so aspergillus is also important in developing of allergic reaction as the body responds by production of IgE antibodies. Increased exposure for the antigen of aspergillus might result in developing an allergic reaction, a form of asthma, but pulmonary lesions are the most associated with developing of aspergillosis especially in immunocompromised patients who are treated with toxic drug and who usually have a form of malignancy or for example are treated with immunosuppressed drugs. All these factors contribute in developing of aspergillosis.

In addition, it's very common to recognize infection with aspergillus in the external ear (external auditory canal) following swimming called external otitis infection. This infection can often be easily observed if you recognize a black discharge from the ears which is an indication for the presence of aspergillus thylum that is black colored and common. Damage in sinuses might also be associated with aspergillus.

So as you see aspergillus is a very important cause of a different localized infections but aspergillus doesn't usually cause any blood sepsis because it's mostly filaments and filaments will only produce localized infection and are not associated with any other type of diseases.
The treatment of aspergillosis is difficult, even if an antifungal drug is used, usually the only way is to have surgical elimination of the organism in addition to the use of an antifungal drug. Usually if the aspergillosis is related to the lungs, it will be very difficult to cure the patient and patient at the end will die following the complications.

There are many other types of filamentous fungi and many other important types of fungal infections related to the respiratory tract that will not be discussed now but rather in the next year.

Unfortunately, the "**" sign indicates words that I couldn't catch and hope they'll be attached to the correction.

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**Corrector Ju.**