



# Microbiology

Doctor 2018 | Medicine | JU

Sheet

Slides

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**DOCTOR**

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Fungal diseases classified into three group:

### 1-fungal allergies.

- Its mechanism is mediated by IgE and eosinophils.
- Notable in *Aspergillus fumigatus*.
- Happens mainly in bronchial (*pulmonary*) infections.

### 2-Fungal toxins (*mycotoxicosis*).

- Fungi that produce toxins e.g. (*Aflatoxin B1*).

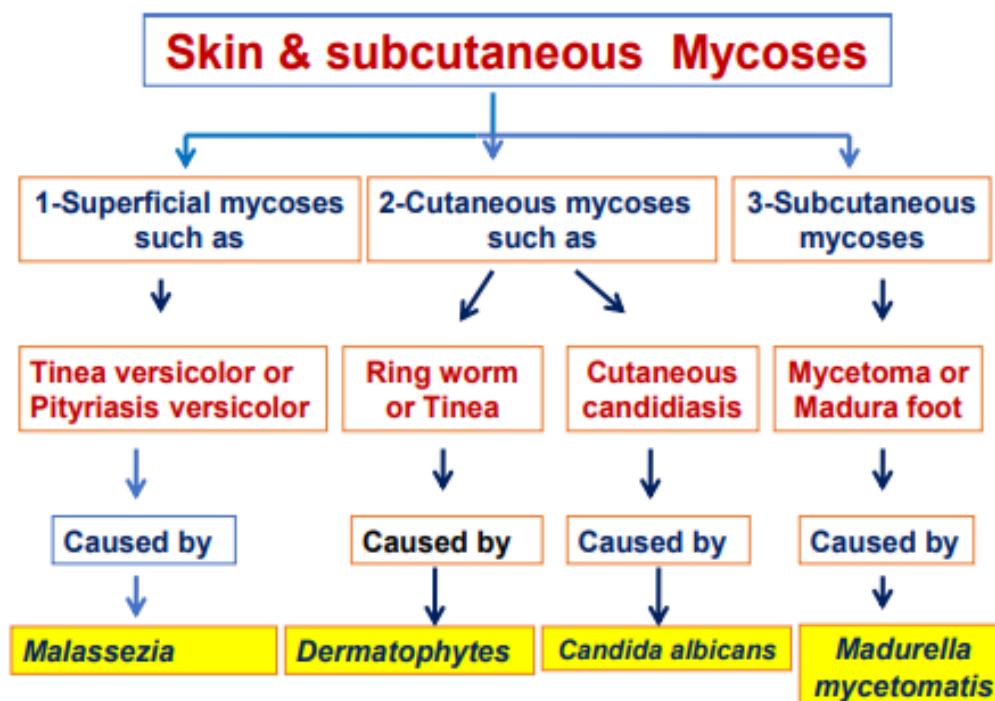
### 3-fungal infection (*mycoses*): the most significant medically.

- Fungal infections are classified according to the location of the infection:

A-superficial mycosis.

B-cutaneous mycosis.

C-subcutaneous mycosis.



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Notes about the previous picture:

1) tinea versicolor = pityriasis versicolor.

2) the difference between superficial mycoses and cutaneous mycoses is that superficial mycoses include skin and hair, while cutaneous mycoses include skin, hair, and nails, another difference is that superficial mycoses doesn't include damage to the tissue or an immunologic reaction while cutaneous mycoses includes both.

3) ring worm = tinea = dermatophytosis (don't mix this tinea with tinea versicolor)

## Superficial Mycosis

A fungal infection of the outer most layer of the skin (stratum corneum/epidermis) which is:

- Normal commensals of skin (part of Normal Flora).
- Can cause skin infections and catheter associated infection.

-Morphology: lipophilic YEAST (round in shape).

Cause by: *Malassezia furfur* and *Malassezia globosa*.

-Examples of infections: **Pityriasis versicolor (Tinea versicolor)**: -

-Pathology: production of carboxylic acid which causes depigmentation.

-Locations of infection: skin, trunk, and proximal limbs.

-common in tropics and precipitated by sun exposure

-hallmarks of it is **hypo/hyperpigmentation** of the skin.

-Depigmentation differ according to: normal background skin of the affected person, severity of disease, and environmental factor as sun exposure.

**HOW** does it look clinically?

- Asymptomatic Non itchy macules which can coalesce (join together) to form scaly plaques.

-lesions are well-demarcated and they are pink, brown or white.

**Hyperpigmentation** means that the skin looks darker than normal

**Hypopigmentation** means that the skin looks lighter than normal.

## Hyperpigmentation



this is a white man with some dark lesions (hyper pigmentation)

## Hypopigmentation



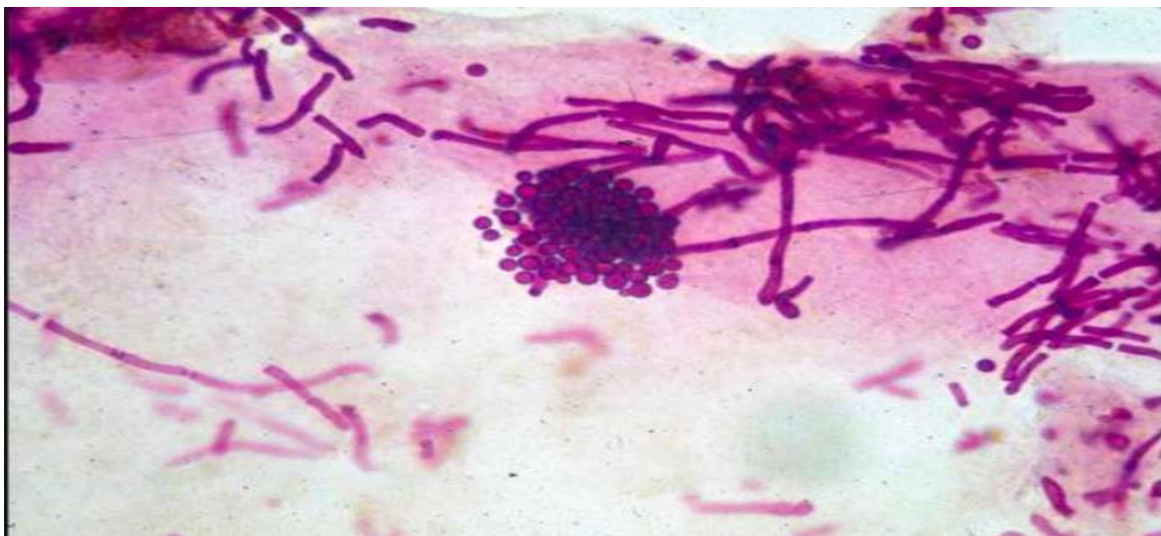
This is a black man with some light lesions (hypopigmentation)

### HOW to diagnose?

- 1- By a device called wood lamp which uses UV light to illuminate skin so, areas of skin where tinea versicolor is present look pale greenish under the UV light.
- 2- Laboratory diagnosis either by microscopy or culturing.

Recap: -

- we treat the sample by KOH that digest most of the tissues & microbes except the fungi because of its cell wall rigidity; which is acquired from the presence of chitin in it.
- We examine the specimen under the microscope without/with staining using the universal stain=**calcofluor wide stain**.



**\*\*This picture shows how Malassezia appears under microscope, it looks like (spaghetti and meatballs).**

**\*\*thick septate hyphae (spaghetti) and clusters of budding oval yeast cells (meatballs).**

### **Treatment:**

This infection is mostly Asymptomatic, so patients seek treatment just for cosmetic reasons; Some resolve spontaneously.

- treatment is by topic antifungal mainly azoles compound, shampoo for 2 weeks or in severe cases use oral azoles; but unfortunately, recurrence is common.

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### Seborrheic dermatitis:

- Hyperproliferation of the scalp caused by Malassezia furfur.

-the mildest manifestation = **dandruff**; Lesions are red and covered with greasy scales and itching is common in the scalp.

-there is an association (**NOT Causation**) relationship between it and Malassezia infection so if we give people with seborrheic dermatitis azoles (antifungals) they progress better.

## Cutaneous Mycoses

Cutaneous infections includes: -skin -hair -nails -immunological responses (induced by the fungi/its metabolites) .

### **Ring worm or tinea (dermatophytosis):**

-caused by dermatophytes (filamentous fungi / molds).

- affects the keratinized tissues of skin (layer under stratum corneum), it doesn't spread to underlying tissues.

-dermatophytes include three genera:( Microsporum, Trichophyton & Epidermophyton).

-it isn't part of the normal flora, so it is classified according to their transmission:



- 1- **Anthropophilic**: from affected person to susceptible one because lesions later will become desquamated so it can transmit after prolonged contact.
- 2- **Zoophilic**: transmitted to humans after prolonged contact with **animals**.
- 3- **Geophilic**: (geo=soil); means transmission by indirect contact through things shared with affected person (intimate objects) as: shower, towel, carpets, etc.

When we reach the cutaneous fungal infection, it means that the skin (which is the first barrier against infections) has been defected.

Be aware that heat, humidity and moisture are favorable conditions to develop fungal infections.

HOW does the Ring worm infection seem clinically?

-it appears as red, itchy scaly rash well demarcated lesions which are ring like in appearance, with a more inflamed raised border.

-outside edges of the ring are redder than the center which have the normal skin color, as if the inflammation is diminished when we go near to the center.

- it could cause Scaling and hair loss leaving black dots (tinea capitis), in a way that could be sever or mild.

- **DDX** (*differential diagnosis*): Eczema, psoriasis, impetigo, alopecia, drug reactions.



- **tinea corporis**: an infection that affects glabrous (hairless) skin.
- **Tinea cruris**: affects the periteneum & proximal thigh.

**Hint//**the whole figure above is important.

- **Tinea pedis:** caused by Trichophyton mentagrophytes; it causes interdigital scalping & dermatophytes in the soles of the foot.
- **Nail infection:**

- isn't involved in the superficial mycosis.

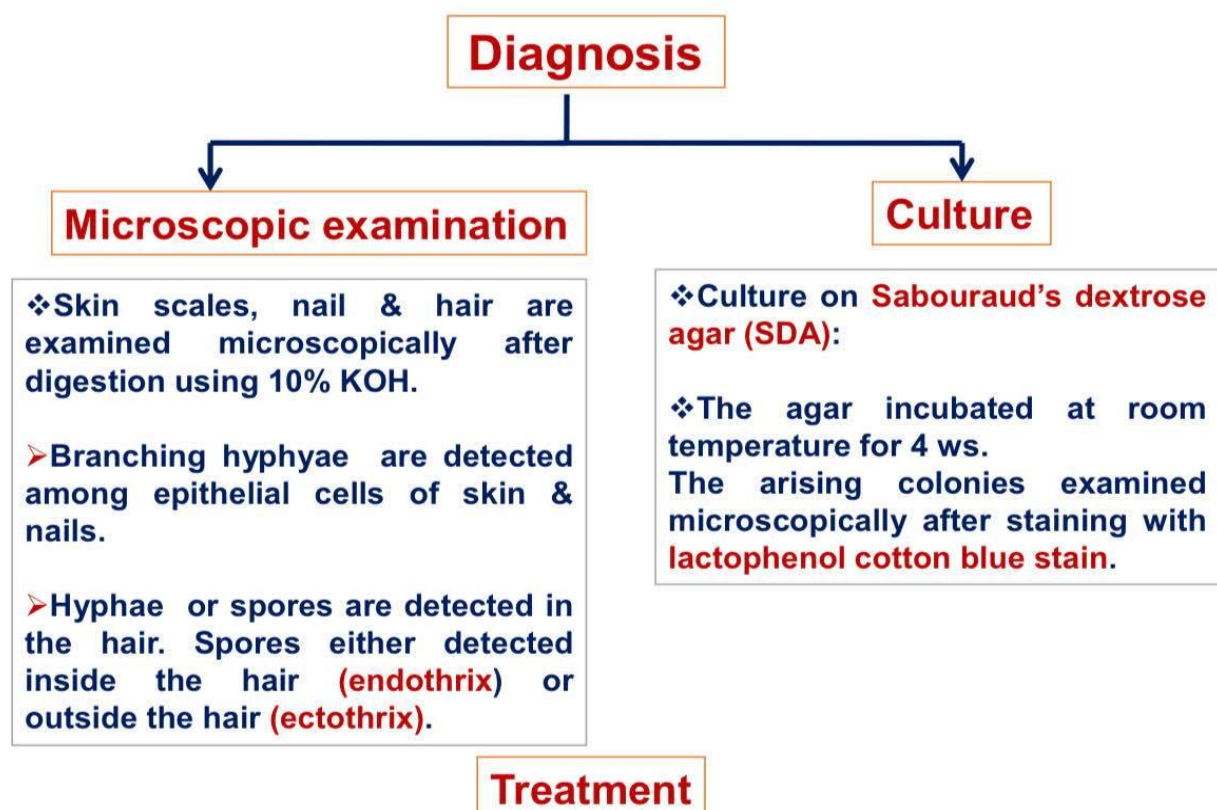
-All fungal infections of the nail fall under the term **Onychomycosis**.

- nails will get thickened with yellow or extremely white opaque decolorization and become brittle (easily breakable); thus, the nail will separate from the nail bed if the patient didn't receive a medical treatment.

-it's painless.

**HOW** to diagnose?

- by microscopic examination or culturing.

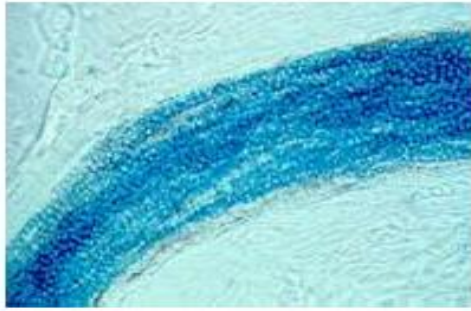


### Treatment

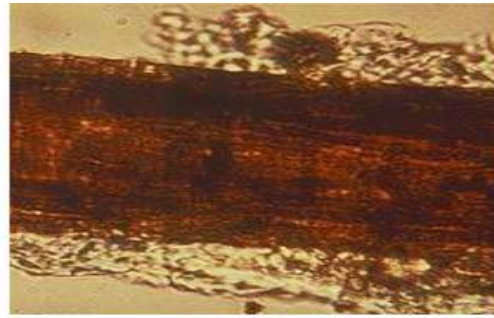
**Local antifungal cream as miconazole or oral terbinafine weeks to months**

-in the hair examination at vitro, spores of fungi are classified into 2 types:

-endothrix: inside & outside the hair shaft. -ectothrix: confound to the hair shaft.



**Endothrix**



**Ectothrix**

dermatophytes have three genera each one has different appearance under the microscope, we must distinguish between them:



*Epidermophyton floccosum*:  
Bifurcated hyphae with multiple, smooth, club shaped macroconidia (2-4 cells)



*Microsporum*:  
Thick wall spindle shape multicellular



*Trichophyton*:  
Large, smooth, thin wall, septate, pencil-shaped

We can examine the three types by culturing them on the Sabouraud's dextrose agar.

## SUBCUTANEOUS MYCOSES

The subcutaneous part of the skin includes the remaining layers of the epidermis & hypodermis; which means that when it gets infected muscles & vessels got damaged.

Let's start examining those infections: -

### Sporotrichosis (rose thorn disease)

A disease caused by the fungi *sporothrix schenckii* that live in the soil; most people who get infected are rose handlers through the skin cuts, in a traumatic transplantation nodule would develop in the forearm as a hallmark of the disease.



## Mycetoma (Madura foot)

Mycetoma is a chronic granulomatous infection usually affects the lower limbs and hands; it's also called the farmer foot disease.

-mode of transition→ traumatic implantation because of cuts & oppressions that defects the skin barrier. Allowing the reservoirs of these fungi which are in the soil to infect the subcutaneous layers in a traumatic way.

Mycetoma can be classified into 2 types depending on the causative agent:

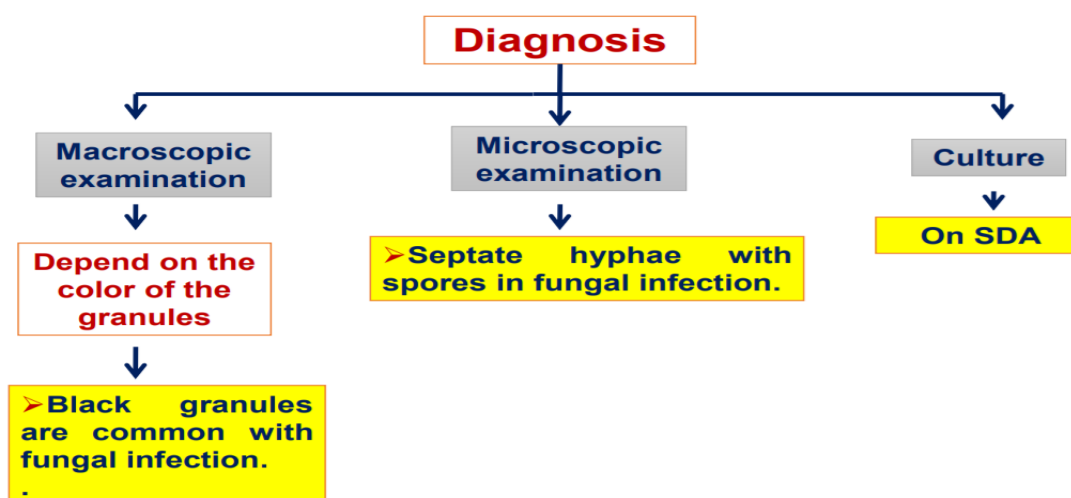
**Eumycetoma**: caused by fungi *Madurella mycetomatis* which have true septate hyphae.

**Actinomycetoma**: caused by species of **actinomycetes** (filamentous aerobic bacteria) e.g: *Actinomyces Israelii*.

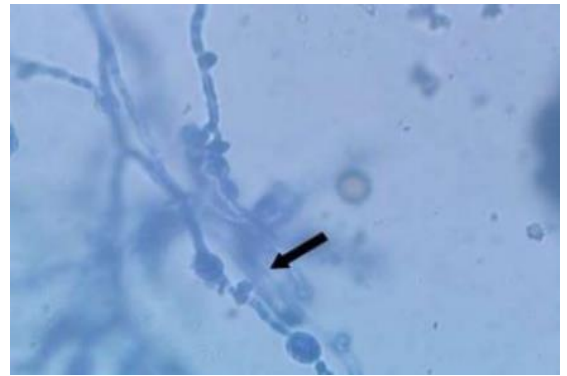
\*This figure shows the clinical picture of mycetoma. Swelling following trauma, purplish discoloration & multiple fistula and sinuses that drain pus containing yellow, white, red or black granules. These nodules are painless, so patients don't tend to seek medical attention.



**NOTE:** You need to differentiate between the two types because each type has its own medications.



\*You'll see under the microscope -after treating the sample with KOH- hyphae having *Intercalary chlamydospores*. These spores are in the middle of the hyphae, unlike candida, whose spores are **TERMINAL**.



**Treatment:** These are serious infections, so we need systemic antifungals such as **Amphotericin B**. Certain azoles can be used orally such as ketoconazole and Itraconazole. Keep in mind that you might need surgical intervention at any time, as patients usually come to you in late stages.

### Opportunistic Mycoses

These are characterized by inability to cause symptomatic infections in normal cases, and some of these species are part of our normal flora. However, they can cause fungal infections in immunocompromised individuals, such as HIV/AIDS patients, diabetics, and those taking immunosuppressive drugs.

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*Remember:*

*Giving broad-spectrum antibiotics can lower our immunity by affecting commensal microorganisms in our body which normally help us defend against pathogens.*

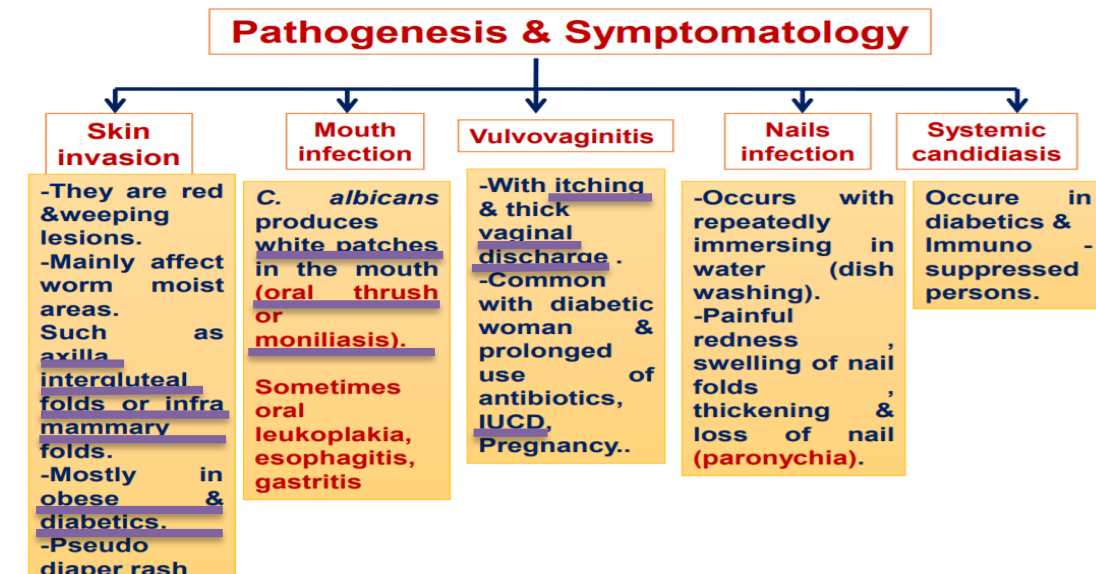
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We are interested in five opportunistic infections starting with the commonest and then mentioning 4 other rare infections.

**1-Candidiasis:** Caused by Candida (mainly Candida albicans), candidiasis varies in severity from simple skin infection to systemic infections. It can be referred to as (endogenous infection) because candida is part of the vaginal, GI and upper respiratory tract normal flora. **Inserting catheters inside the body can induce candidiasis.**

*Remember:*

*Candida are a kind of yeast (oval cells that reproduce by budding) and can form pseudo hyphae. It is referred as (pleomorphic) which means that it can be found as hyphae as well.*



## NOTES:

- \*Things mentioned by the doctor in the figure above are **underlined**.
- \*Nail infections are painful, unlike tinea unguium infections which are painless
- \*Systemic candidiasis is the most dangerous as it can lead to infective endocarditis.
- \*Candida dermatitis is always accompanied with oral lesions, from which we can differentiate it from other contact (also called napkin, nappy rash) dermatitis.

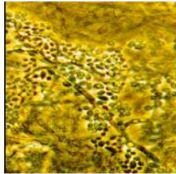
This figure shows another common type of candida infections, called candida fingerweb. It is most common among cooks and people who deal with hot water.



## Laboratory diagnosis

### Direct microscopic examination

- Specimens from skin, vaginal discharge or exudates from mucous surfaces are examined.
- *C. albicans* is oval gram positive budding yeast cell with pseudohyphae.



### Culture

On nutrient agar, corn meal agar & SDA. Colonies are creamy in color & identified by:

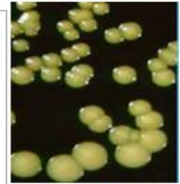
1- **Morphology:** oval budding gram +ve yeast cells.

2- **Differentiation tests:**

a. **Germ tube test :** germ tube is formed when colonies incubated with human serum at 37 C for 30 min.

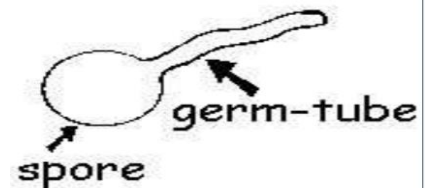
b. **Chlamydospore** formation on corn meal agar.

c. **Biochemical reactions:** *C. albicans* ferments glucose & maltose with acid & gas production.



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\*If this germ tube is formed, we can make sure that this is **C. albicans**.



\*You can see under the microscope chlamydospores which are terminal (at the ends of hyphae).

(These are characteristics of Candida)



**Treatment:** Varies depending on the type of infection. For skin infections for example, topical or oral treatments can be given, e.g: Nystatin. But keep in mind that systemic infections need systemic antifungals, our one and only **Amphotericin B**.

## 2-Cryptococcus neoformans (Cryptococcosis):

-Exogenous infections, reservoirs are soil and pigeon droppings.

-Causes 'avian cryptococcosis' in birds and lung infections, as well as meningitis in humans (It is neurotropic – prefers to migrate to neurons)

-It has a capsule which contributes to its pathogenicity



**Diagnosis:** Cerebrospinal fluid sample, we add 'India ink stain' which stains the capsule. For the culture, we use a special agar called (bird seed agar). **REMEMBER: Bird droppings – Bird seed agar.**

### 3-Aspergillus (Aspergillosis):

- We are concerned with 3 species: A. fumigatus, A. flavus, A. parasiticus
- A. fumigatus is the most common and is associated with fungal allergies.
- A. flavus and A. parasiticus are associated with production of fungal toxins as well as invasive aspergillosis. The site of entry for these invasive aspergilloses is usually the lungs, but they form 'fungal balls' in body cavities, which need surgeries to be removed. **The prognosis of these cases is poor.** For treatment you need a systemic antifungal (**Amphotericin B**) and surgery.

### 4-Zygomycosis (Mucormycosis):

- It has 3 members: Rhizopus, Absidia, and Mucor.
- They are associated with a disease called **Rhinocerebral mucormycosis** (usually involves mouth and nose)
- The worst prognosis of all opportunistic mycoses, patients die rapidly.
- The main host defense is phagocytosis
- Diagnosis is made by direct smear and by isolation of molds from respiratory secretions or biopsy specimens.
- Treatment: Control Diabetes, surgery & **Amphotericin B**

### 5-Pneumocystis:

- Pneumocystis jirovecii is the cause of a lethal pneumonia in immunocompromised persons, **particularly those with AIDS.**
- The organism cannot be grown in culture.
- TMP-SMX is treatment of choice.

## Endemic(systemic) mycosis

**Endemic:** They are always found in certain areas.

**Systemic:** They involve many systems of the body.

- Endemic mycosis is caused by a thermally dimorphic fungus, and the infections are initiated in the lungs following inhalation of the respective spores.
- Each of the four primary systemic mycoses - **coccidioidomycosis**, **histoplasmosis**, **blastomycosis**, and **paracoccidioidomycosis** - is geographically restricted to specific areas.
- Most infections are asymptomatic or mild and resolve without treatment. However, a small but significant number of patients develop pulmonary disease.

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*Remember:*

*Dimorphic fungi alternate between two forms. They are found as hyphae in the environment and as yeast in the human body (37° C).*

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*Good Luck!!*