Medical Mycology

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Learning Objectives

- Introduction to Mycology
- Compare the major characteristics of specific superficial fungal diseases affecting keratinized structures
- Discuss briefly diagnostic methods used for diagnosis of superficial fungal infections

Mycology

- Is the study of fungi
- Fungi are responsible for fungal diseases called **mycoses**
- Most are saprophytes in soil and on decaying plant material.
- Used in industries: production eg bread, cheese, wine and beer.
- Implicated in spoilage of fruits, grains, vegetables and jams.

General properties of fungi

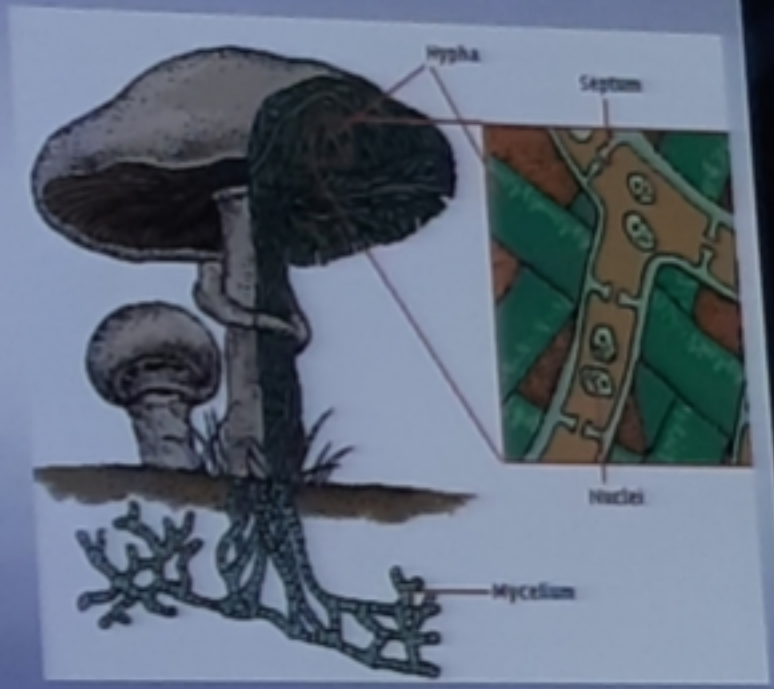
1. They are **eukaryotic**
2. Have **ergosterols** in their membranes
3. Have a rigid cell wall made of **chitin**
4. **lack chlorophyll**
5. typically **not motile**, although a few (e.g. Chytrids) have a motile phase.
6. Typically reproduce asexually and/or sexually by producing **spores**

Characteristics of Fungi

Structures

- Their bodies are made up of slender woven filaments called **hyphae**.

- Hyphae form **mycelium**, a tangled mass that make up the fungi structures.

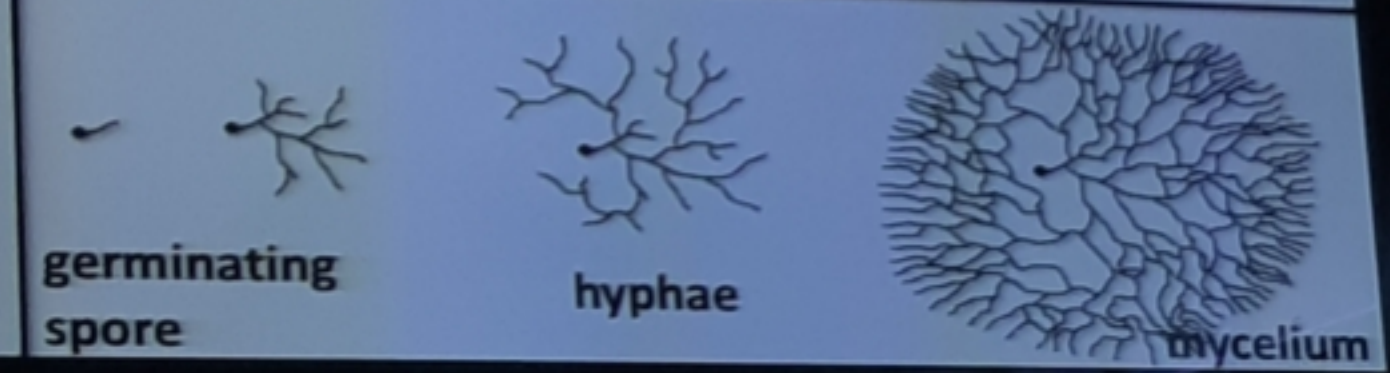


Structure of fungi

- Fungi exist in three forms; **moulds, yeast and dimorphic fungi**

Moulds (Molds):

- **multicellular** - form branching filaments called **hyphae**
- A mass of hyphae collectively make up the **mycelium**



Dimorphic fungi

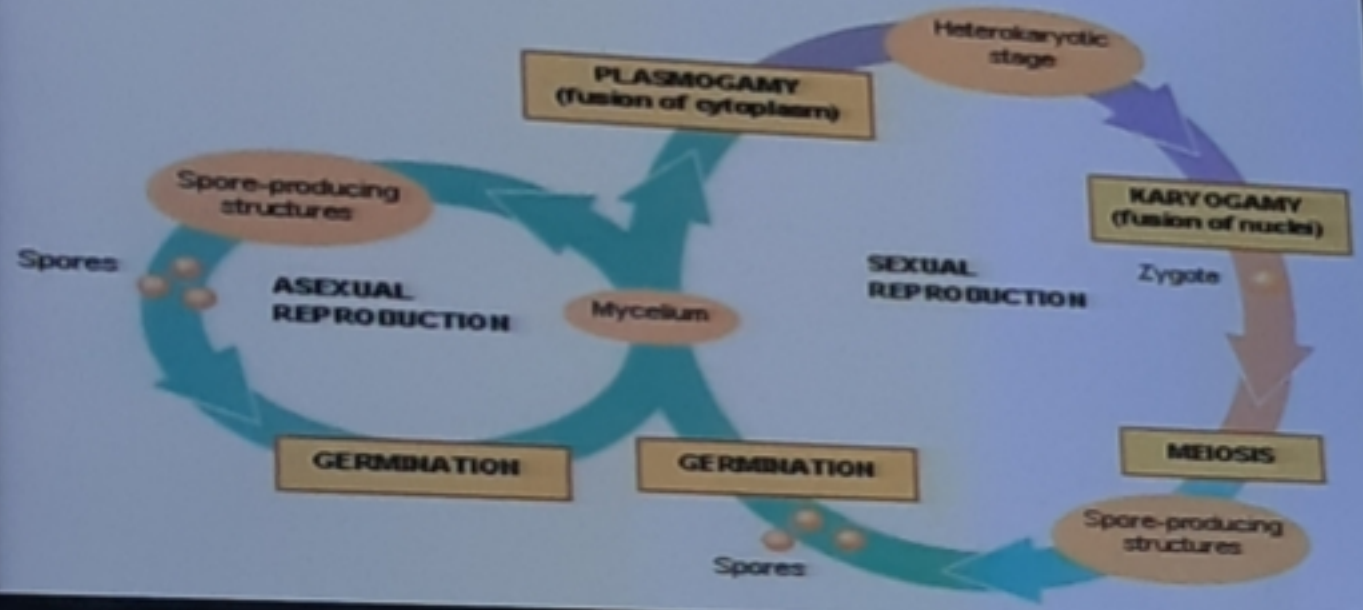
- Some fungi exist in both yeast and mycelial forms. These fungi are called **dimorphic fungi.**

Yeast form: a parasitic or pathogenic form. This form is usually seen in tissue of patients. Can be cultured at 37 ℃.

Mycelial form: a saprophytic form. This is the form existing in nature. Can be cultured at 25 ℃.

Reproduction of fungi

- Reproduce both asexually and/or sexually by producing spores.
- Asexual spores are formed on or in specialized structures.



PATHOGENIC FUNGI

- Disease cycle similar to virus and bacteria
- Can not only penetrate host via wounds or natural opening, they can also actively penetrate via production of appresoria – allows direct penetration through mechanical and enzymatic activity

Appresoria – swollen tips of hyphae

Fungal Pathogenicity (virulence factors):

- Ability to **adhere** to host cells
- **capsules** allowing them to resist phagocytosis
- Ability to **damage host by secreting enzymes** such as keratinase, elastase, collagenase
- Ability to secrete **mycotoxins**
- Exhibiting **thermal dimorphism**

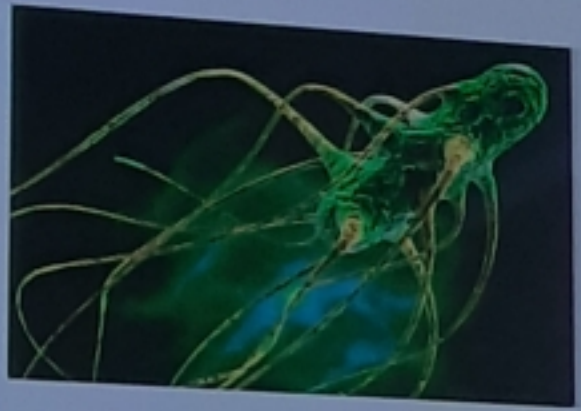
Laboratory diagnosis

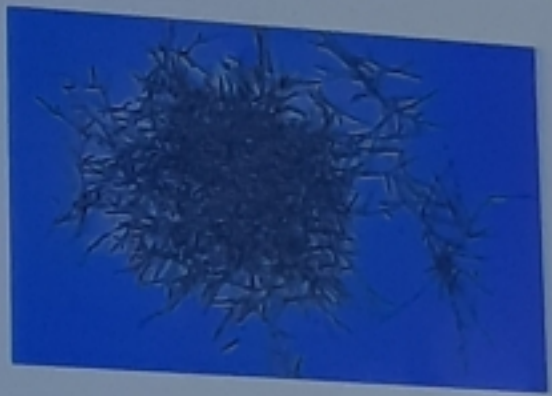
- There are five approaches to the laboratory diagnosis of fungal diseases:
  - direct microscopic examination,
  - culture of the organism
  - histology/cytology
  - DNA probe tests
  - serologic tests

Microscopy:

- **Wet mount**: yeast cells may be observed in urine wet mounts
- **10-20% KOH mount**: Several specimens are subjected to KOH mount for direct examination
- **lactophenol cotton blue** stains the fungal elements blue
- **India Ink:** Capsules of *Cryptococcus neoformans*
- **Gram stain:** yeast cells

Fungi differ from bacteria in several aspects:





FEATURE	FUNGI	BACTERIA
Nucleus	Eukaryotic	Prokaryotic
Cytoplasm	Mitochondria, Endoplasmic reticulum present	Mitochondria, Endoplasmic reticulum absent
Cell membrane	Sterols present	Sterols absent- except mycoplasma
Cell wall content	Chitin	Peptidoglycan

FEATURE	FUNGI	BACTERIA
Spore	for reproduction	for survival
Thermal dimorphism	Yes (some)	No
Metabolism	No Obligate anaerobes	Many Obligate anaerobes

Fungal specimens

Fungal discussion

- The most common fungi isolated in KNH theatres were *Aspergillus spp* 45 (39.8%). *Aspergillus fumigatus* alone at 36(31.9%) with the least being Candida observed only once((<1%).
- Mixed growths of *Penicilium* were (9.7%).
- These results were similar to Poland which found Aspergillus spp at (35%) of the isolates (Gniadek & Macura, 2011).

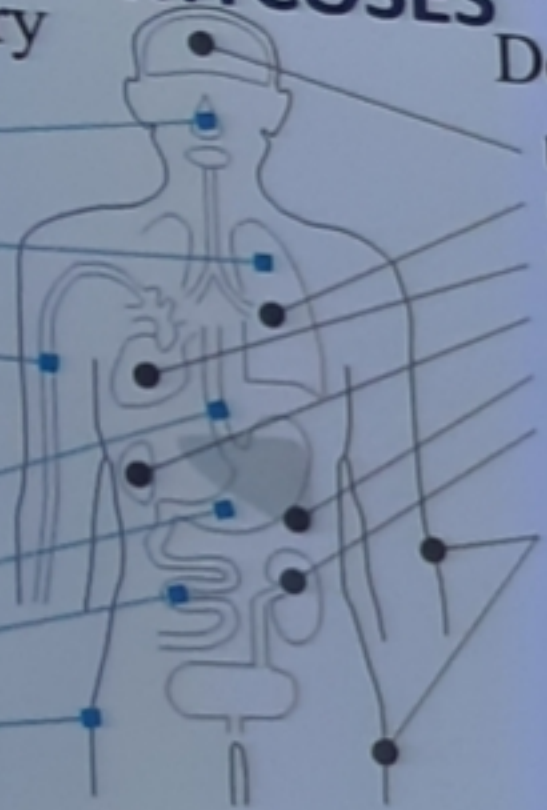
PATHOGENESIS

- Mycoses- 4 categories:
  - **Superficial**
  - **Cutaneous**
  - Subcutaneous
  - Systemic
  - opportunistic

MYCOSES

utes of entry

- nasal
- sinuses
- lungs
- blood vessels (for example via injury/catheters)
- oesophagus
- stomach
- intestine
- skin



Deep mycoses

- brain
- lungs
- heart
- spleen
- liver
- kidney

cutaneous mycoses

- superficial (on skin, hair, nails)
- cutaneous (within skin, hair, nails)
- subcutaneous (beneath skin)

Pathogenic Fungi

TRUE PATHOGENS

Cutaneous infective agents

- Epidermophyton species
- Microsporum species
- Trichophyton species

Subcutaneous infective agents

- *Actinomadura madurae*
- *Cladosporium*
- *Madurella grisea*
- *Phialophora*
- *Sporothrix schenckii*

Systemic infective agents

- *Blastomyces dermatitidis*
- *Coccidioides immitis*
- *Histoplasma capsulatum*
- *Paracoccidioides brasiliensis*

Cutaneous mycoses

Panasonic

Superficial mycoses

- superficial cosmetic fungal infections of the skin or hair shaft
- no living tissue is invaded
- no cellular response from the host
- no pathological changes
- patients unaware of infection

Etiologic agents

- Caused by fungi known as dermatophytes
- Dermatophytes are keratinophilic - "keratin loving".
- produce extracellular enzymes (keratinases) which are capable of hydrolyzing keratin.
- dermatophytes are classified into 3 genera:

1.Microsporum

- hair, skin, rarely nails

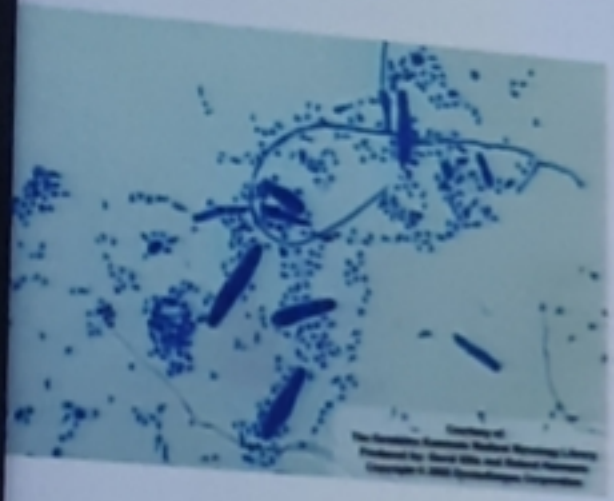
2. Trichophyton

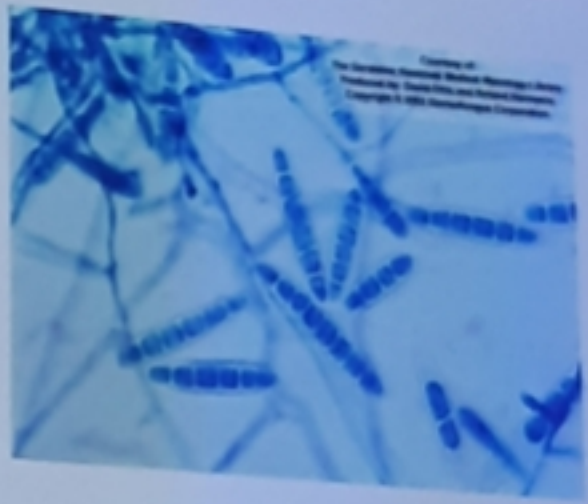
- hair, skin & nails

3. Epidermophyton

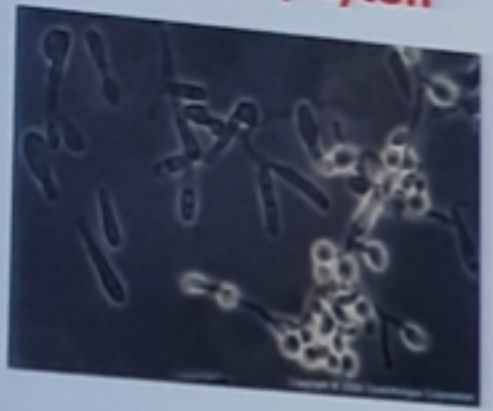
- skin, nails, rarely hair

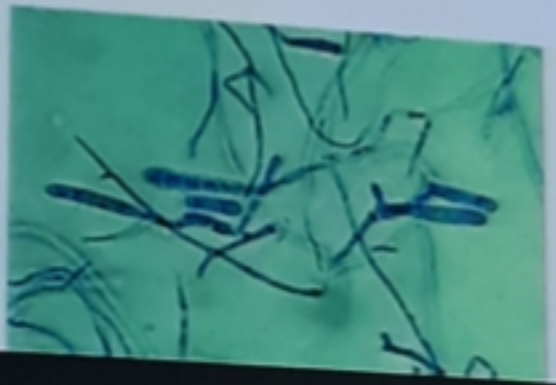
Trichophyton species





Epidermophyton





Clinical Classification

- Produce ring-like lesions(**ring-worm** or **tinea)**
- The clinical forms of the disease are named according to the site affected;
  - **Hairy areas:**
    - **Tinea capitis**
    - **Tinea barbae**
  - **Skin:**
    - **Tinea coporis**
    - **Tinea cruris** (Jock itch)
    - **Tinea manum**
    - **Tinea pedis** (Athlete's foot)
    - **Tinea fascie**
  - **Nail:**
    - **Tinea ungium**

Tinea capitis

- Ringworm of the scalp, eyebrows and eyelashes
- occurs in childhood and usually heals spontaneously
- infection takes place just above the hair rootby ***M. audouinii, M. canis, M. ferrugineum, T. mentagrophytes, T. verrucosum*** and ***T. megninii.***

Tinea barbae

- also known as **Barber's itch, Ringworm of the beard, and Tinea sycosis**
- is a fungal infection of the hair around the bearded area of men.
- is most commonly caused by **T.verrucosum, T.mentagrophytes, and T.rubrum.**
- may be infected with bacteria.

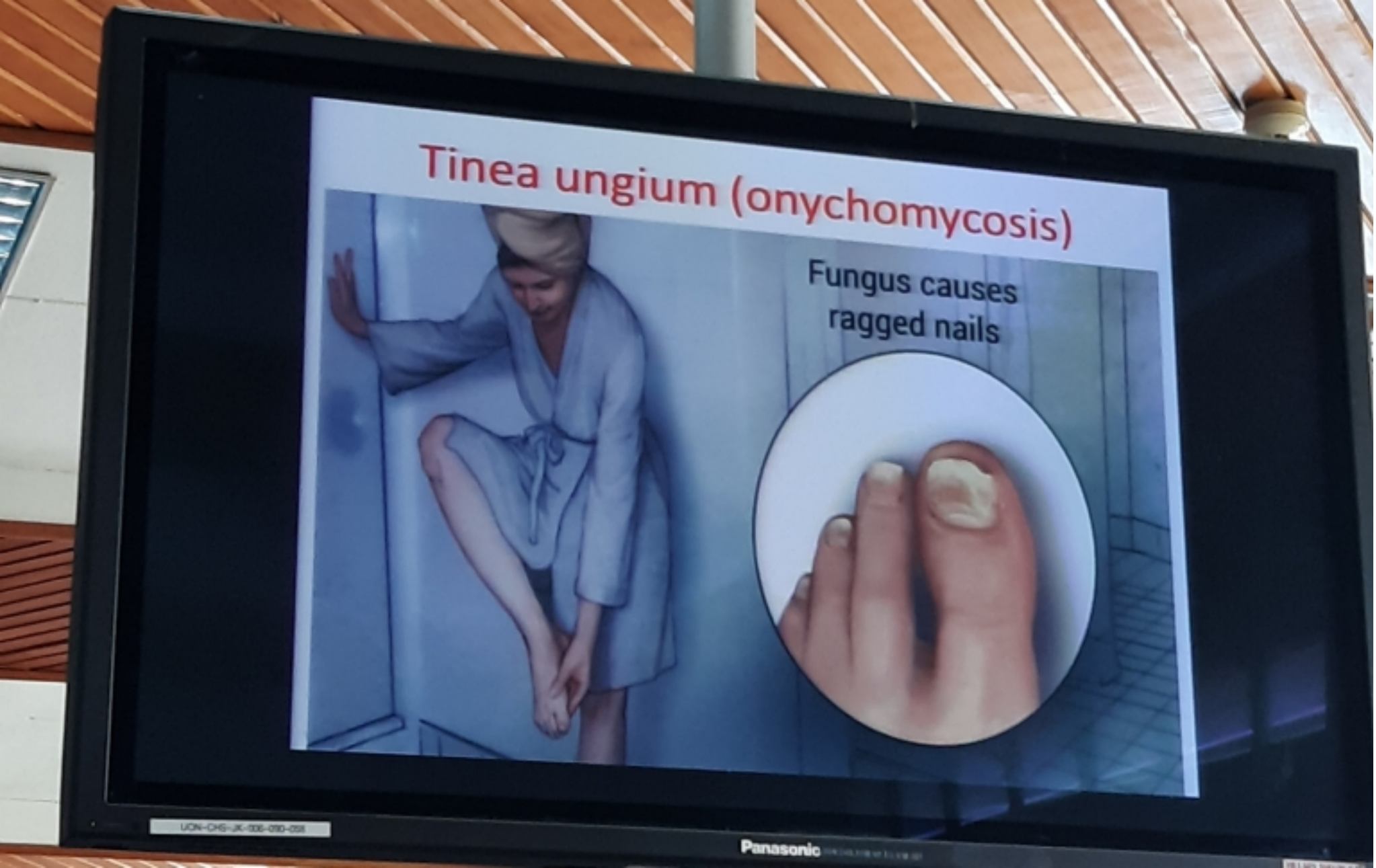
Tinea corporis

- Classic "ringworm"
- Trunk, extremities, face
- Elevated, scaly, pruritic lesions with erythematous edge
- Anthropophilic and zoophilic causes
  - ***T. rubrum***

Tinea manuum

- Ringworm of the palms and interdigits
- Common among patients with tinea pedis
- Symptoms generally resemble that of tinea pedis
- Etiological agent: ***T. rubrum*** **&** ***T. mentagrophytes***

E. floccosum


Tinea ungium (onychomycosis)
Fungus causes
ragged nails
Panasonic

Tinea ungium (onychomycosis)

- nails become yellow, brittle, thickened or crumbling
- May be caused by dermatopytes or candida
- ***T. rubrum*** most common

TINEA NIGRA

- Caused by two black filamentous fungus: ***Exophiala werneckii* and *Cladosporium castellani*.**

- The clinical presentation is an irregular black or brown spot, generally solitary, which slowly enlarges.

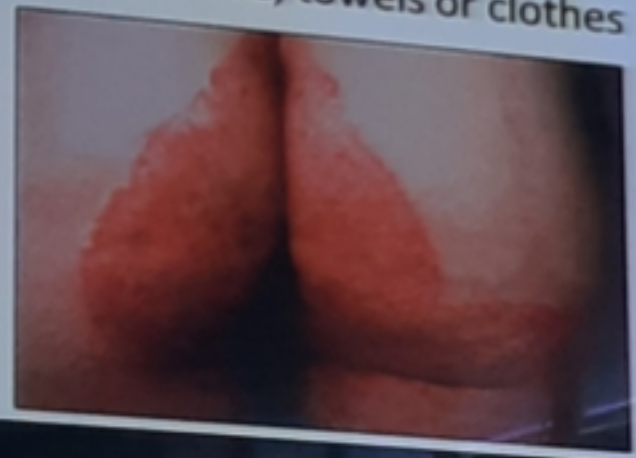
- The infection has rather long times of incubation also, in some cases, of years.

Tinea Pedis (Athletes Foot)

- is an acute to chronic fungal infection of the feet, commonly called athlete's foot.
- Scaling of soles
- most prevalent of all dermatophytoses
- infected with anthropophilic dermatophytes - **T. rubrum, T mentagrophytes ,E. floccosum**
- Prone to secondary bacterial infection – lymphangitis and lymphadenitis

Tinea cruris

- is an acute or chronic fungal infection of the groin, commonly called **jock itch**.
- Often starts on the scrotum and spread to the groin as dry, itchy lesions
- is caused by **E. floccosum, T. rubrum, T. mentagrophytes**, or yeasts like Candida.
- Mode of transmission: Sharing of linens, towels or clothes



Tinea versicolor

- Also called **Pityriasis versicolor**
- fungal infection of the epidermidis that manifests as hypopigmented or hyperpigmented skin patches
- Caused by the ***Malassezia globosa or Malassezia furfur***
  - These yeasts are lipophilic yeast
  - Live on the skin as part of the normal flora
- Lab diagnosis
  - KOH mount of skin scales- short, curved, septate hyphae and budding yeast-like cells (spaghetti and meatballs appearance)

Pityriasis (Tinea) versicolor

Black piedra

- fungal infection of the hair shaft
- caused by ***Piedra hortae*,**
- forming **hard black nodules** on the hair shafts
- epidemics in families have been reported following the sharing of combs and hairbrushes

Laboratory diagnosis:

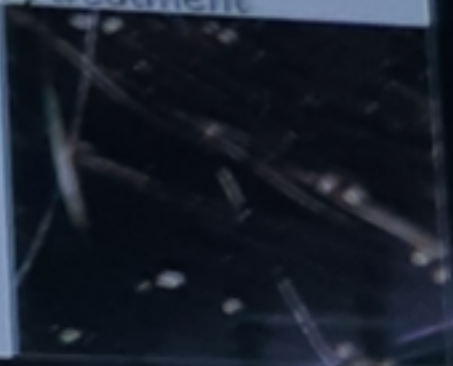
- KOH preparation of the hair reveals a dark pigmented nodule surrounding the hair shaft **containing asci**.
- Rx-terbinafine

White piedra

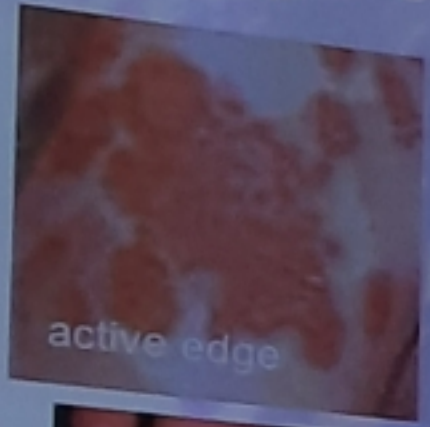
- fungal infection (*Trichosporum beigelii*) of the hair shaft
- Infected hairs develop soft greyish-white nodules along the shaft.

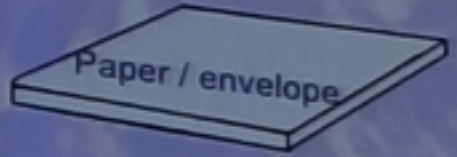
Laboratory diagnosis:

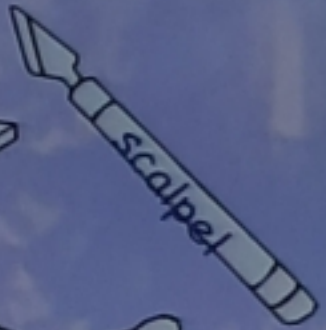
- KOH preparation of the hair reveals white or light brown nodules
- Rx-Topical application of an imidazole
- Shaving off infected hairs is a satisfactory treatment



Skin scraping specimen







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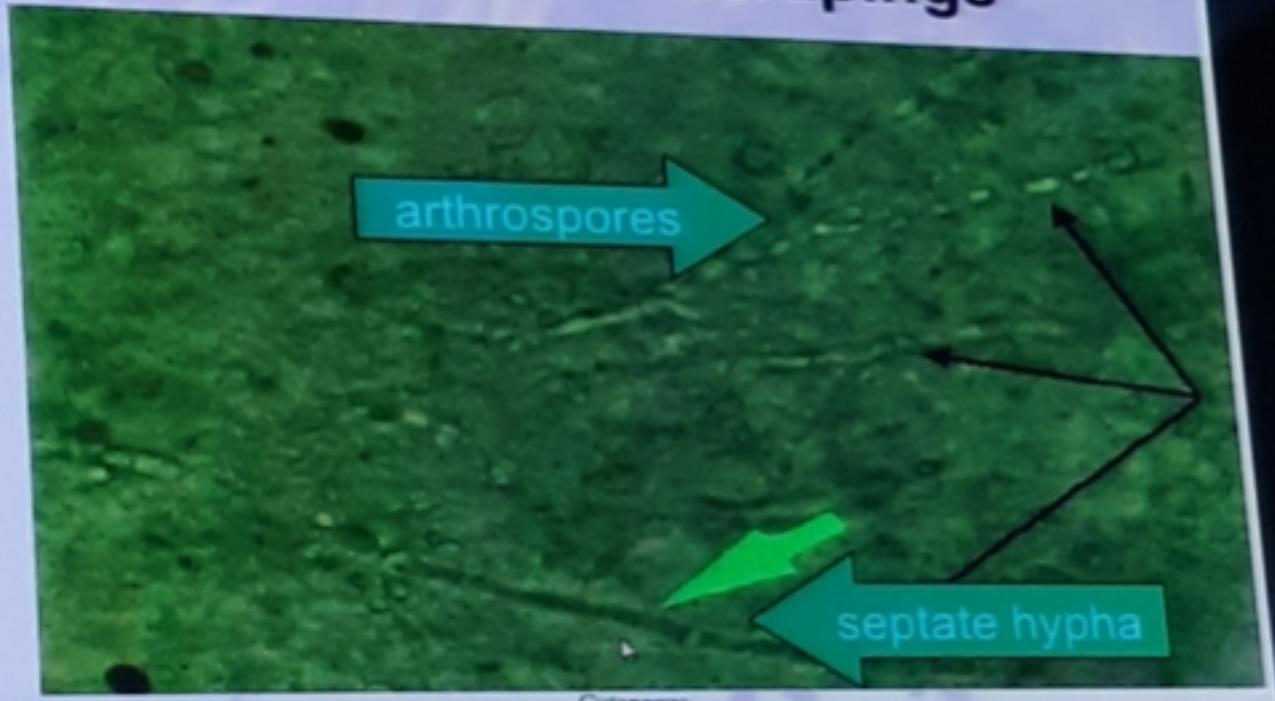
Direct Examination

- **Wet mount**
- KOH
  - 10% to 30%
  - with Parker Superquink blue-black ink
  - gentle warming

KOH of skin scrapings



Culture:

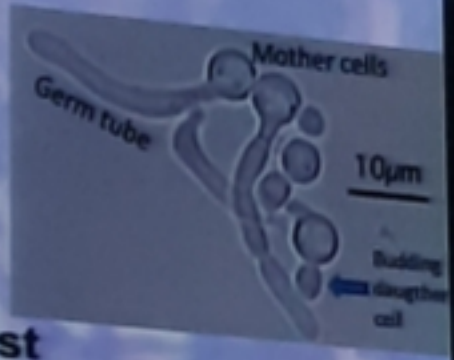
- Non-selective medium
  - Sabouraud's dextrose agar
- **Selective media**
  - **SDA with chloramphenicol & cycloheximide (Mycosel or Mycobiotic agar)**
  - **Dermatophyte test medium**

Candida albicans in SDA

Trichophyton terrestre in SDA

Laboratory Methods for Diagnosis of Mycoses

- III. Biochemical Tests:
  - *Rapid kits for yeasts
  - *Urea test



- IV. Special Tests:
  - *In-vitro hair perforation test
  - *Germ tube test
  - *Chlamydoconidia formation test

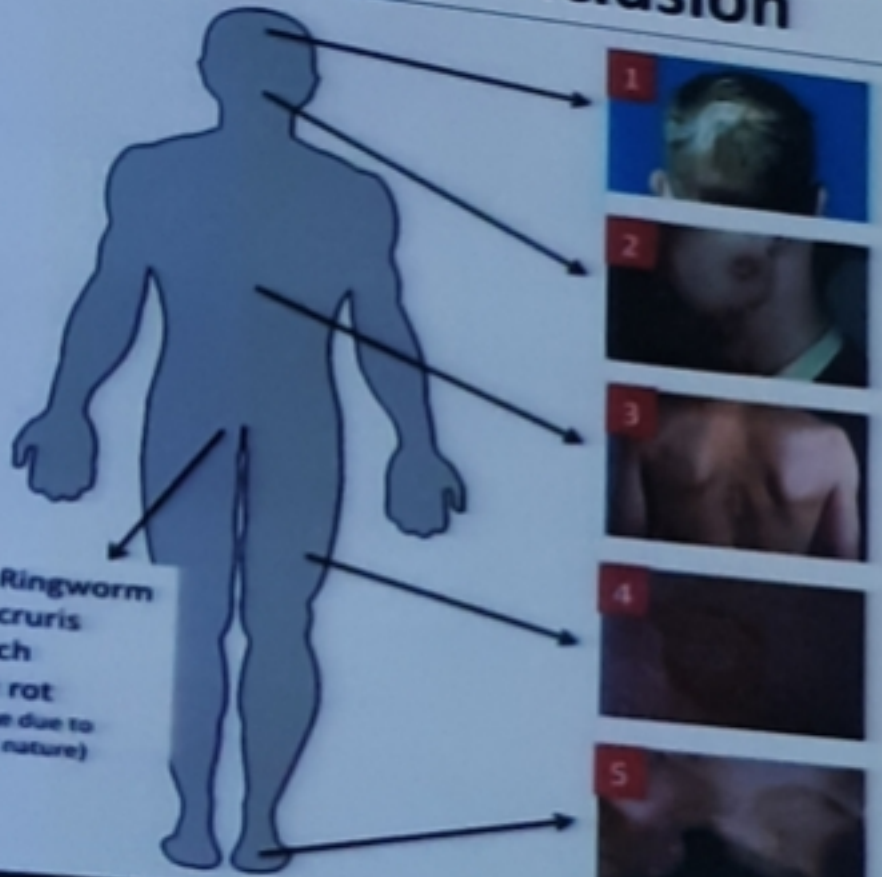
Treatment

- **Topical**
  - nonspecific – Whitfield's ointment
  - Specific – creams, lotions, shampoos of Azole derivatives- Clotrimazole, ketoconazole etc.
- **ORAL ANTIFUNGALS** – required for nail scalp and severe skin infection includes griseofulvin, terbinafine, itraconazole

Prevention

- control depends on cleanliness, sterilization of instruments (using hot mineral oil),effective treatment of cases and reduced contact with infectious materials

Conclusion



Groin Ringworm
Tinea cruris
Jock itch
Crotch rot
(no image due to sensitive nature)

Scalp Ringworm
Tinea capitis

Ringworm of beard area
Tinea barbae or
Barber's itch

Tinea versicolor

Ringworm of the body
Tinea corporis

Ringworm of the toes
Tinea pedis or
Athlete's foot