Clinical Mycology

- Superficial mycoses
- Cutaneous mycoses
- Subcutaneous mycoses
- Systemic mycoses
- Opportunistic fungal infection
CUTANEOUS MYCOSES

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DEFINITION AND GENERAL CHARACTERISTICS OF CUTANEOUS MYCOSES

Fungal diseases that affects the skin, hair and nails.

They are generally restricted the keratinized tissue.

They cause inflammatory response.
DERMATOPHYTOSES

• Etiological fungi are called “dermatophytes” (They are keratinophilic fungi)

• There are 3 genera

  *Microsporum*
  *Trichophyton*
  *Epidermophyton*

• Dermatophyte infections are called Tinea (=ringworm)
Ring worm
DERMATOPHYTES ARE CATEGORIZED INTO 3 TYPES

ACCORDING TO SOURCES OF INFECTION

1. Geophilic dermatophytes
2. Zoophilic dermatophytes
3. Anthropophilic dermatophytes
GEOPHILIC DERMATOPHYTES

Inhabit soil where they decompose keratinaceous debris of dead animals

Microsporum gypseum

Microsporum nanum
ZOOPHILIC DERMATOPHYTES

Parasitic on animals

Trichophyton equinum, Microsporum canis, M. mentagrophytes var mentagrophytes
Primarily parasitic to man. Man as exclusive host for maintenance and dissemination of species

- *Trichophyton rubrum*
- *Trichophyton schoenleinii*
- *Trichophyton tonsurans*
- *Trichophyton mentagrophytes var interdigitale*
- *Microsporum audounii*
- *Epidermophyton floccosum*
Severity of infections

Geophilic and zoophilic >> Anthropophilic

However, these infections are less likely to become chronic than those caused by anthropophilic organisms.
Clinical manifestations of dermatophytoses

A. Skin invasion = ringworm

B. Hair invasion

Favic type (inside, with oil deposits and air)

Ectothrix type (outside; the hyphae are accumulated around the hair shaft)

Endothrix type (inside)
Tinea capitis
Scalp, eyebrow, eyelashes

Tinea favosa
Cup shaped crusts
Tinea corporis
Rings with scaly centers

Tinea imbricata
Concentric rings caused by
*T. concentricum*
Tinea barbae  
Bearded area of face and neck

Tinea cruris  
Jock itch, moist groin area
Tinea pedis
Athlete’s foot
Toe webs, soles and nails

Tinea manuum
Interdigitate areas and palmar surfaces
Tinea unguium (Onychomycosis)

Invasion of nail plate

Thickened, discolored and brittle nails
Laboratory diagnosis of dermatophytoses

Skin scraping, infected hair

↓

KOH preparation
Potassium hydroxide (KOH): dissolves keratin and free hyphae from the cell

Arthroconidia

Septate hyphae

Cell remnant
Calcofluor white (CFW) stains chitin at the cell wall

Need fluorescent microscopy.
Improve the sensitivity and specificity of diagnosis
Culture:
SDA or SDA with chloramphenicol and cycloheximide (mycosel agar) at room temperature at least 2 weeks

Identification:
Gross colors and textures
Microscopic characteristics
Trichophyton rubrum

• White, cottony colony. Wine red pigment on reverse side.
• Pencil-shaped macroconidia
• Microconidia (club-shaped, tear drops)
Trichophyton mentagrophytes

- Flat, white to cream color, powdery to granular surface
- Cigar-shaped macroconidia
- Microconidia present
- Coiled or spiral hyphae
Light brown, powdery colony

*Microsporum gypseum*

Spindled-shaped macroconidia, Microconidia present
**Epidermophyton floccosum**

- Fluffy colony
- Club-shaped macroconidia
- Microconidia ABSENT
**Dermatophytes**

- **Microsporum**: Infect skin, hair and nails
  - Microscopic appearance
    - Macroconidia: Rough walled
    - Microconidia: Present
  - Macroconidia > microconidia

- **Trichophyton**: Infect skin and hair
  - Microscopic appearance
    - Macroconidia: Smooth walled
    - Microconidia: Present
  - Microconidia > macroconidia

- **Epidermophyton**: Infect skin and nails
  - Microscopic appearance
    - Macroconidia: Smooth walled
    - Microconidia: ABSENT
  - Chlamydoconidia
A heterogenous group of infections characterized by the development of a lesion at the site of inoculation (subcutaneous)

**Major**
- Mycetoma
- Sporotrichosis
- Chromoblastomycosis

**Minor**
- Hyalohyphomycosis
- Phaeohyphomycosis
- Entomophthoromycosis
Major route of infection

Traumatic implantation

Lesions on the skin surface

Infection at subcutaneous tissue

Fascia, Bone
General characteristics

• Fungal pathogens are found as saprobes in soil, plants, and decomposing vegetation.

• Usually found in tropical or subtropical regions (sporotrichosis is also prevalent in temperate regions)

• Combination of drugs and surgical may be indicated for therapy.

• For diagnosis, the fungus must be seen in specimens or lesions and the fungal morphology must be consistent with the patient’s symptoms.
Mycetoma
(Madura foot, Maduromycosis)

Chronic granulomatous infection

Lower limbs are most commonly affected
A clinical syndrome characterized by localized, swollen lesions of cutaneous and subcutaneous tissues with later involvement of muscle and bone.

**Triad of symptoms**

1. Tumefaction
2. Draining sinuses
3. **Grains/Granules**

\[300 \mu m - 5 \text{ mm}\]

Grains = combination of microcolonies of the causative organism and proteinaceous materials from the host.
The color of grains may suggest the likely diagnosis:

- Black: Fungal infection
- Red: Actinomadura pelletieri
- Minute white: Nocardia
- Larger white or Yellow white: Fungal or actinomycotic origins
Eumycotic mycetoma

Hyaline fungi

*Pseudallescheria boydii*
*Acremonium falciforme*
*Acremonium recifei*
*Aspergillus nidulans*

White to yellow grains

Dematiaceous fungi

*Exophiala jeaneselmei*
*Madurella grisea*
*Madurella mycetomatis*

Brown to black grains
Pseudallescheria boydii

At first white and woolly, become gray to black

Gray to black at reverse
P. boydii produces both sexual and asexual conidia in culture

“Cleistothecia” (Sexual ascocarps)

50-200 μm, dark-brown to black

Walls are composed of 2-3 layers of septate hyphae

Clavate to subglobose asci (contain up to 8 ascospores)
Anamorphs

*Scedosporium apiospermum*

Single, lemon-shaped annelloconidia

“Synnemata” (bundles or tulfs of conidiophores)
Etiologic agents

True fungi $\rightarrow$ Eumycotic mycetoma

Actinomycetes $\rightarrow$ Actinomycotic mycetoma

Eumycotic mycetoma = Mycetoma that caused by true fungi

Actinomycotic mycetoma = Mycetoma that caused by fungal-like bacteria in Actinomycetes group
Actinomycotic mycetoma = Mycetoma that caused by fungal-like bacteria in Actinomycetes group (higher bacteria)
Diagnosis of Mycetoma

Specimen collection: Aspiration (best), drainage, tissue biopsy/section

- **Examination of grains**
  - Record size, color, shape and consistency of grains

- **Direct microscopic examination:** KOH/LPC preparations
  (LPC = lactophenol cotton blue)
Tissue staining
Gram’s/H&E/GMS

Eumycetoma

Actinomycetoma
• **Culture**  Standard mycological media or aerobic/anaerobic bacterial culture condition

**Treatment**

Treatment is difficult due to inability of drugs to infiltrate lesions. Combination of medicine and surgery is the best.

- *Eumycotic mycetoma*: Amphotericin B
- *Actinomycotic mycetoma*: Antibiotics
SPOROTRICHOSIS
(ROSE GARDENER’S DISEASE)

Chronic infection characterized by nodular lesions of the cutaneous or subcutaneous tissues and adjacent lymphatics.
Sporotrichosis

Causative agent: *Sporothrix schenckii*

Thermal dimorphic fungus Commonly found in soil worldwide

- **25 °C Mycelial form**
- **37 °C Cigar-shape yeast**
25 °C

Brown, flat, leathery to velvety colony

37 °C

White or beige yeastlike colony

Sleeve arrangement

Cigar-shape yeast cells

Rosette pattern

25 °C

White or beige yeastlike colony

37 °C

Brown, flat, leathery to velvety colony
Five types of infection:

- Lymphocutaneous
- Fixed cutaneous
- Mucocutaneous
- Disseminated (AIDS)
- Pulmonary

Factors:
- Portal of entry
- Dose
- Host response
LYMPHOCUTANEOUS SPOROTRICHOSIS

Primary lesion

wrist

5 days-6 mt. after inoculation
Fluctuant nodule
Eventually attaches to the overlying skin, becomes black and necrotic

Secondary lesion

1° healing, 2° developing

Develoeps at another lymphnode proximal to the 1st one
Diagnosis of sporotrichosis

Samples: Aspiration fluids, pus, biopsy

Direct examination:
- KOH, Histopathological staining (H&E, GMS)
- yeast cells and Asteroid body

Cultivation: Dimorphism property

Serology: Sporotrichin skin test
Asteroid bodies

Characteristics of sporotrichosis

Complex of antigenic material from the fungus and antibody from host

Star shape (rays of an eosinophilic material) radiating from a central yeastlike cell (basophilic)
Treatment of lymphocutaneous sporotrichosis = Potassium iodide in milk (oral)
Chromoblastomycosis
Mostly found in Central and South America

Verrucous cauliflower-like lesions

Tissue form = Sclerotic bodies

A vegetative rounded multicell with cross and longitudinal septa of dematiaceous fungi, characteristic of chromoblastomycosis
**Causative agents**: Dematiaceous fungi in genus:

*Fonsecaea, Phialophora, Cladosporium*

**Identification**: Arrangement and shape of spores

Phialophora  Cladosporium  Fonsecaea  Rhinocladiella
<table>
<thead>
<tr>
<th>Organism</th>
<th>Conidial type</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cladosporium carrionii</em></td>
<td>Cladosporium</td>
</tr>
<tr>
<td><em>Phialophora verrucosa</em></td>
<td>Phialophora</td>
</tr>
<tr>
<td><em>Rhinocladiella aquaspersa</em></td>
<td>Rhinocladiella</td>
</tr>
<tr>
<td><em>Fonsecaea pedrosoi</em></td>
<td>All 4 types</td>
</tr>
</tbody>
</table>
Fonsecaea pedrosoi

Velvety to cottony texture
Both surface and reverse is brownish black, olive, gray black or jet black in color
Hyalohyphomycosis

Hyalohyphomycosis = Infection caused by hyaline contaminant fungi (*Fusarium* spp)

Phaeohyphomycosis = Infection caused by dematiaceous fungi (*Cladosporium* spp)

Symptoms are similar

Identification of the causative agent is important because treatment varies
Entomophthoromycosis
(subcutaneous zygomycosis)

The disease caused by fungi in entomophthoromycetes group
e.g. Basidiobolus sp., Conidiobolus sp.

(Zygomycoses = Broadest term to call the infections due to members of Zygomycetes)
TABLE 12-1. Taxonomy of the Agents of Zygomyosisis

<table>
<thead>
<tr>
<th>Kingdom fungi</th>
<th>Phylum Zygomycota</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class Zygomycetes</td>
<td></td>
</tr>
<tr>
<td>Order Mucorales</td>
<td></td>
</tr>
<tr>
<td>Family Mucoraceae</td>
<td></td>
</tr>
<tr>
<td>Absidia corymbifera</td>
<td></td>
</tr>
<tr>
<td>Apophysomyces elegans</td>
<td></td>
</tr>
<tr>
<td>Mucor insidous</td>
<td></td>
</tr>
<tr>
<td>Mucor racemosus</td>
<td></td>
</tr>
<tr>
<td>Mucor circinelloides</td>
<td></td>
</tr>
<tr>
<td>Rhizomucor pusillus</td>
<td></td>
</tr>
<tr>
<td>Rhizopus arhizus</td>
<td></td>
</tr>
<tr>
<td>Rhizopus azygosporus</td>
<td></td>
</tr>
<tr>
<td>Rhizopus microsporus var. microsporus</td>
<td></td>
</tr>
<tr>
<td>Rhizopus microsporus var. rhizopodiformis</td>
<td></td>
</tr>
<tr>
<td>Family Cunninghamellaceae</td>
<td></td>
</tr>
<tr>
<td>Cunninghamella bertholletiae</td>
<td></td>
</tr>
<tr>
<td>Family Saksenae</td>
<td></td>
</tr>
<tr>
<td>Saksenaea vasiformis</td>
<td></td>
</tr>
<tr>
<td>Order Entomophthorales</td>
<td></td>
</tr>
<tr>
<td>Family Entomophthoraceae</td>
<td></td>
</tr>
<tr>
<td>Conidiobolus coronatus</td>
<td></td>
</tr>
<tr>
<td>Conidiobolus incongruus</td>
<td></td>
</tr>
<tr>
<td>Family Basidiobolaceae</td>
<td></td>
</tr>
<tr>
<td>Basidiobolus ranarum</td>
<td></td>
</tr>
</tbody>
</table>

- **Mucormycosis**
- **Entomophthoromyosisis**
- **Zygospores**
Broad aseptate hyphae, may be surrounded by an eosinophilic sheath (Splendore-Hoepli phenomenon)
Basidiobolus ranarum

globose conidia

Adhesive conidia
**Conidiobolus spp.**

Three types of asexual spores

- Papillae conidia
- Villose conidia
- Corona conidia
Entomophthoromycosis due to *Basidiobolus*

They cause infections with different localizations

- Proximal parts of the limbs
- Occur in childhood and adolescence rather than adult

Entomophthoromycosis due to *Conidiobolus*

- Facial areas (nose, cheek, upper lips)
<table>
<thead>
<tr>
<th></th>
<th>Mycetoma</th>
<th>Sporotrichosis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Common site</strong></td>
<td>Lower limbs</td>
<td>Upper and Lower limbs</td>
</tr>
<tr>
<td><strong>Representative organism</strong></td>
<td>P. boydii, E. jeanselmei</td>
<td>S. schenckii (dimorphic)</td>
</tr>
<tr>
<td><strong>Appearance of lesion</strong></td>
<td>Tumefaction, draining sinuses, grain</td>
<td>Ulcers, painless nodules</td>
</tr>
<tr>
<td><strong>Microscopic elements in specimen</strong></td>
<td>Grains</td>
<td>Asteroid bodies</td>
</tr>
<tr>
<td><strong>Lymphatic involvement</strong></td>
<td>No</td>
<td>Spreads along lymphatic channels</td>
</tr>
<tr>
<td></td>
<td>Chromoblastomycosis</td>
<td>Phaeohyphomycosis</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td><strong>Representative</strong></td>
<td><strong>Dema. fungi</strong></td>
<td><strong>Dematiaceous</strong></td>
</tr>
<tr>
<td><strong>organism</strong></td>
<td><em>(Fonsecaea, Cladosporium, Phialophora)</em></td>
<td><strong>contaminant</strong></td>
</tr>
<tr>
<td><strong>fungi</strong></td>
<td></td>
<td><strong>fungi</strong></td>
</tr>
<tr>
<td><strong>Appearance of</strong></td>
<td><strong>Cauliflower-like</strong></td>
<td><strong>Nodules,</strong></td>
</tr>
<tr>
<td><strong>lesion</strong></td>
<td><strong>lesion</strong></td>
<td><strong>ulcers</strong></td>
</tr>
<tr>
<td><strong>Microscopic elements</strong></td>
<td><strong>Sclerotic</strong></td>
<td><strong>Black hyphae</strong></td>
</tr>
<tr>
<td><strong>in specimen</strong></td>
<td><strong>bodies</strong></td>
<td></td>
</tr>
</tbody>
</table>
## Entomophthoromycosis due to

<table>
<thead>
<tr>
<th>Causative fungi</th>
<th>Basidiobolus ranarum</th>
<th>Conidiobolus incongruus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common site</td>
<td>Lower limbs</td>
<td>Face, Lips</td>
</tr>
<tr>
<td>Incidence</td>
<td>childhood and adolescence</td>
<td>Adult</td>
</tr>
</tbody>
</table>
Bibliography
