Fungal Infections

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Disclosures

• No financial relationships to disclose
Learning Objectives

• Understand the causes of fungal infections
• Illustrate and recognize their clinical presentations
• Review latest evidence-based treatment guidelines
Introduction to Mycology

• Fungi first appeared 1.5 billion years ago
• Among earliest organisms domesticated by humans
• Serious problem only since 20th century
• 1.5 million fungal species known
• Less than 100 are pathogenic to humans
• Except for dermatophytes, not contagious
Classification of Fungal Diseases

• Superficial
  - Do not have ability to invade skin, hair, or nails

• Cutaneous
  - Dermatophytes

• Deep
  - Localized subcutaneous (implantation or dermal spread)
  - Dimorphic systemic (hematogenous spread)
  - Opportunistic (immunocompromised patients)
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Superficial Fungal Infections

• Pityriasis versicolor
• Tinea nigra
• Black piedra
• White piedra
Pityriasis Versicolor
Spores and hyphae in stratum corneum ("spaghetti and meat ball")
Treatment of Pityriasis Versicolor

• Topical ketoconazole very effective against *Malassezia*
• Oral fluconazole and itraconazole as effective with lower recurrence
• Oral ketoconazole not recommended (FDA warning)
• Oral terbinafine not effective
Tinea Nigra

_Hortaea werneckii_  (melanin-producing yeast)
Black Piedra and White Piedra

*Piedra Hortae*  
*Trichosporon beigelii*
Differential Diagnosis of Piedras

Trichomycosis axillaris
*Corynebacterium*

Head Lice
*Pediculus humanus capitis*
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Cutaneous Mycoses

- Dermatophytoses of skin, hair, and nails
- Candidiasis of skin, mucous membranes, and nails
- Do not invade subcutaneous tissue
Dermatophytosis

- *Microsporum, Trichophyton, and Epidermophyton*

- Most common causes:
  - Tinea capitis – *T. tonsurans*
  - Tinea faciei – *T. rubrum*
  - Tinea corporis – *T. rubrum*
  - Tinea pedis – *T. rubrum*
  - Bullous tinea pedis – *T. mentagrophytes*
  - White superficial onychomycosis – *T. mentagrophytes*
  - Distal & proximal subungual onychomycosis – *T. rubrum*
Clinical and mycological effect of clotrimazole/betamethasone dipropionate cream versus ketoconazole cream in patients with tinea cruris

RJ Pariser & DM Pariser

Eastern Virginia Medical School, Department of Medicine, Division of Dermatology, Norfolk, VA, USA

• betamethasone did not compromise the antifungal effects of clotrimazole

• clinical endpoints consistently favored the combination drug, which relieved symptoms more rapidly
• Once daily application is as effective as twice daily, with better compliance

• Azoles, benzylamines, and allylamines show no difference in clinical effectiveness

• Azole-corticosteroid combination achieved higher clinical cure rates than azole monotherapy

• Duration inadequately addressed
• When given for 2 weeks, Terbinafine has statistically significantly better cure rates than Itraconazole, Fluconazole, Ketoconazole, and Griseofulvin.

• Itraconazole for 4 weeks as effective as 2 weeks of Terbinafine
Tinea Treatment: Summary

**TOPICAL**
- Any topical antifungal, once daily for 2-4 weeks
  - *optional*: add moderate potency topical steroid

**ORAL**
- Terbinafine 250mg once daily for 2 weeks
Fungal folliculitis

• Tinea capitis
• Tinea barbae
• Majocchi’s granuloma

• Require treatment with oral antifungals
- Fungi thought to have evolved to survive harsh winters and resist temperatures < 50°C, but authors conjecture:
  - Fungi may be secondarily destroyed as tissue necrosis occurs
  - Rapid cooling forms intracellular ice crystals and disrupts the cell membrane
  - Rewarming damages the cell membrane again and stimulates the immune system
Experimental study on cryotherapy for fungal corneal ulcer

Yingxin Chen¹, Weijia Yang², Minghong Gao¹*, Michael Wellington Belin³, Hai Yu¹ and Jing Yu¹
Dermatophytid ("id") reaction

• Hypersensitivity reaction to dermatophyte antigens
• Classic presentation is vesicular eruption on the sides of fingers with inflammatory tinea pedis
• Examine the feet in all cases of suspected hand eczema!
• Eruptions can also be urticarial and panniculitic
Onychomycosis (Tinea Unguium)

- *T. rubrum* (most common), yeast, nondermatophyte molds
- Superficial white onychomycosis
- Distal lateral subungual onychomycosis
- Proximal subungual onychomycosis
Onychomycosis Treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Mycologic Cure Rate (negative KOH and culture)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Topical Ciclopirox (Penlac)</td>
<td>29%</td>
</tr>
<tr>
<td>Topical Tavaborole (Kerydin)</td>
<td>35%</td>
</tr>
<tr>
<td>Topical Efinaconazole (Jublia)</td>
<td>55%</td>
</tr>
<tr>
<td>Oral Fluconazole (Diflucan)</td>
<td>48%</td>
</tr>
<tr>
<td>Oral Itraconazole (Sporanox)</td>
<td>54%</td>
</tr>
<tr>
<td>Oral Terbinafine (Lamisil)</td>
<td>77%</td>
</tr>
</tbody>
</table>
Candidiasis

• *C. albicans* inhabits skin, GU, and GI tract
• Opportunistic pathogen
• Frequently infects intertriginous areas
• Predisposing factors include hygiene, diabetes, antibiotic use, and immunosuppression
• Clinical spectrum can range from short-lived superficial to overwhelming systemic infections
Candidiasis Treatment

**TOPICAL**
- Any topical antifungal for cutaneous candidiasis
- Rinse-and-spit with fluconazole solution is superior to nystatin and amphotericin B for thrush

**ORAL**
- Fluconazole 50-100mg/day (95%+ success rate)
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Deep Fungal Infections

<table>
<thead>
<tr>
<th>Subcutaneous</th>
<th>Systemic</th>
<th>Opportunistic</th>
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</thead>
<tbody>
<tr>
<td>Sporotrichosis</td>
<td>Blastomycosis</td>
<td>Cryptococcosis</td>
</tr>
<tr>
<td>Phaeohyphomycosis</td>
<td>Histoplasmosis</td>
<td>Aspergillosis</td>
</tr>
<tr>
<td>Chromomycosis</td>
<td>Coccidioidomycosis</td>
<td>Fusariosis</td>
</tr>
<tr>
<td>Mycetoma (Madura foot)</td>
<td>Paracoccidioidomycosis</td>
<td>Mucormycosis</td>
</tr>
<tr>
<td>Lobomycosis</td>
<td></td>
<td>Penicilliosis</td>
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<tr>
<td>Rhinosporidiosis</td>
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<tr>
<td>Zygomycosis</td>
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</tbody>
</table>
Sporotrichosis

• DDX: Atypical mycobacterium, Nocardia, Leishmania, Tularemia
Chromomycosis

- *Fonsecaea pedrosoi* (most common cause)
Madura Foot (Mycetoma)
Lobomycosis

- *Lacazia loboii*
- “keloidal blastomycosis”
- Dolphins
Opportunistic Systemic

• Disseminate in immunocompromised patients
  - Organ transplant, post-chemotherapy, HIV
• *Candida* species most common
Mucormycosis