
Dermatophytoses/Ringworms*
The tinea

an "infection" produced by a dermatophytic fungus growing in the keratinized tissue of man and other animals

2. Dermatophytic fungi (dermatophytes)

- a large, closely related group of keratinophilic fungi which causes "infections" in skin, hair and nail.

- form-species	<i>Microsporum</i> ***
(anamorphs)	<i>Trichophyton</i> ***
of <i>Arthroderma</i> **	<i>Epidermophyton</i> ***

*vs dermatomycoses - any mycosis of skin

** Plectomycetes (Eurotiomycetes)

***Hyphomycetes, Moniliaceae

Dermatomycoses vs Dermatophytosis

All mycosis of skin and hair

vs

dermatophytoses which:

1. include several clinical entities named after, or indicative of, the anatomical site of infection e.g. tinea pedis, ringworm of the foot.
2. have a pathology that is
 - a) initially eczemaform
 - b) followed by DTH allergic and inflammatory manifestations e.g. ids (dermatophytids)

History

Greeks - herpes for circular lesions

Romans - tineas - for small insect larvae

Remak, 1830, observed arthroconidia and hyphae in hair shafts of favus patients (didn't publish immediately)

Schoenlein, 1839, formally published favus caused by fungus

Remak, 1840-45, published his observations confirming Schoenlein's conclusions - also carried out successful self-inoculation, and named *T. schoenleinii*.

Gruby, 1830-40, also published series of papers that confirmed independently and extended Remak's and Schoenlein's conclusions:

1. confirmed favus caused by fungus
2. described beard dermatophytosis*
3. described epidemic of prepubertal scalp ringworm**
4. recognized there were three distinct types of scalp ringworm***
5. also describes the isolation of the favus fungus on potato slices and its culture and subsequent ability to cause infection (self-inoculation) (Koch's postulates??) ~1875 with *B. anthracis*

*fungus named *Microsporum (Trichophyton) mentagrophytes* in 1853 by Robin.

**caused by *M. sudouinii*, which he named.

***endothrix, ectothrix & favus

Microsporum

Arthroderma

Trichophyton

1. heterothallic and dimictic (need opposite mating types and mating controlled by two sets of compatible genes* at a single mating-type locus).
2. all members of the Ascomycota

*idiomorphs - since genes at same locus not really alleles, but sets of genes that may code nonhomologous proteins

Dermatophyte Taxonomy

Holomorphs/Teleomorphs

Phylum -	Ascomycota
Subphylum--	Euascmycotina (Pezizomycotina)
Class -	Plectomycetes (Eurotiomycetes)
Order -	Onygenales (because gymnothecia and thalloconidia)
Family -	Gymnoascaceae (most authorities)
	Arthrodermataceae*
Genus -	<i>Arthroderma</i> * sp

Fungi Imperfecti/Anamorphs

Form-class -	Hyphomycetes
Form-order-	Moniliales
Form-family-	Moniliaceae
Form-genera-	<i>Epidermophyton</i> sp
	<i>Trichophyton</i> sp
	<i>Microsporum</i> sp

* If recognize Arthrodermataceae, then *Arthroderma* must be member.

Onygenales* vs Eurotiales**

Thalloconidia vs Phialoconidia

Majority of dermatophytes produce holothallic arthroconidia, whereas minority produce holoarthric arthroconidia

Some may produce both

*gymnothecia vs **cleistothecia

*prosenchymatous plectenchyma (loose hyphae) walls make up ascocarp

**pseudoparenchymatous plectenchyma (tight or obscured hyphae) walls make up ascocarp

*prototunicate asci =

(spherical & scattered in random fashion)

asci

ascospores

Why not routinely confirm sp ID by inducing teleomorphs?

Too much work!

Why?

1. all sexual strains are heterothallic and dimictic
2. tester strains would have to be maintained, or isolates sent to reference labs
3. the most common pathogens of man are, so far, known only as imperfects
4. treatment is usually possible without knowledge of absolute identity of species
5. species ID most important for epidemiology-type studies; DNA IDs will help

Hypothetical Trend Toward Anthropophilism in Dermatophytes

1. group of soil saprophytes becomes adapted to keratin utilization (possibly shed animal hair & skin scales)
 2. some of these fungi become associated more directly with furred animals & gain ability to form transient "infections"
 3. a subset of these adapt to growth on keratinized zones of animals & man
 4. some of these equilibrate with host in a way that only slight host reaction occurs
 5. of these a few develop specialized methods of reproduction different than their geophilic cousins: includes formation of special types of arthroconidia in hair, and possibly the loss of frequent sexuality
 6. finally some become associated more or less specifically with certain hosts, including man
 - possibly different keratins
 - segregation of strains & species?
 - loss of a mating-type
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- Growth *in vitro* - 1) retarded or inhibited at 37°C
2) killed at 41°C
- Growth *in vivo* only rarely invade deeper tissue (dermis & subcutaneous tissue)

Review

Dermatophytoses/Ringworms - The tinea

- an infection produced by a dermatophytic fungus growing in the keratinized tissue of man and other animals

dermatophytic fungi (dermatophytes)

- a large, closely related group of keratinophilic fungi which causes infections in skin, hair and nail

- form-species of the form-genera *Microsporum*
(known or suspected anamorphs) *Trichophyton*
of genus *Arthroderma* *Epidermophyton*

include several clinical entities named after, or indicative of, the anatomical site of infection e.g. *Tinea pedis*, ringworm of the foot

have a pathology that is

- a) initially eczemaform
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TABLE 8-8. Present Status of Dermatophytosis
Tinea Capitis

In developed countries:

Anthropophiles diminishing or eliminated. *M. audouinii*, *T. tonsurans*, *T. violaceum*, *T. schoenleinii*
Zoophiles steady or increasing. *M. canis*, *T. mentagrophytes* var. *mentagrophytes*

In developing countries:

Steady or decreasing in Asia and Latin America. *T. violaceum*, *T. schoenleinii*, *T. tonsurans*
Increasing in Africa. *M. audouinii*, *T. soudanense*, *T. schoenleinii*, *M. ferrugineum*, *T. violaceum*
tinea pedis, tinea cruris, tinea corporis, tinea unguium

In developed countries:

Increasing. *T. rubrum*, *T. mentagrophytes* var. *interdigitale*, *E. floccosum*
Increasing in all countries, the universal dermatophyte: *Trichophyton rubrum*

From Rippon

Also see handout of Common N.A. Dermatophytes

Hair Colonization Types*

1. Ectothrix invasion
- involves a dermatophytic fungus which has hyphae that fragment into arthroconidia* on the surface of the hair shaft, or just beneath the hair cuticle**
2. Endothrix invasion
- involves a dermatophytic fungus which has hyphae that fragment into conidia*** within the hair itself
3. Favus - no conidiation in or on hair

* holoarthric thalloconidia (micro-conidia)

** sometimes involves "hair-penetrating organ"

***noted by Gruby in 1830s

Tinea Capitis

1. "Prepubertal," "gray patch," "classical scalp ringworm," "epidemic ringworms"
M. audouinii and *M. canis**
ectothrix/small conidia** Wood's lamp +(green) uv = 365nm
2. Black dot *Trichophyton*
endothrix/large conidia**
3. Favus *T. schoenleinii*
no conidia on hair Wood's lamp +(dull blue)
4. Nondescript - *Trichophyton* infections
ectothrix usually/but rare
e.g. *T. rubrum*

* more inflammatory

** holoarthric conidia of hair

Prepubertal/Gray Patch/Classical

- a. associated with young children usually boys ~ 5:1
- b. gray-patch refers to hair areas becoming grayish, lusterless, and discolored within first days of infection
- c. hairs subsequently become weakened & break off in mass leaving large gray patches
- d. itching mild to severe *M. canis* > *M. audouinii*
- e. best described and known type in 1940s & 50s in U.S. because of epidemics - Epidemic Ringworm of U.S.
- f. spontaneous cures common corresponding to onset of puberty (hormonal link?)
- g. Wood's lamp (UV=365nm) screens of school children look for fluorescence of brilliant green due to pteridines in hyphae
- h. cures -
 - epilation
 - X-ray + epilation
 - topicals
 - griseofulvin
 - azoles

Tinea Imbricata

- a. specialized tinea corporis by *T. concentricum*
- b. associated with certain Pacific islands; possibly introduced into South America by pre-Columbian travelers
- c. polycyclic lobed ring patterns accentuated by raising of skin scales at margins
- d. passed from mother to newborn on purpose sometimes to establish beauty marks
- e. chronic, life-long disease
- f. antifungal cures often followed by severe remission

Tinea Cruris (jock itch)

- a. similar to tinea imbricata & tinea corporis, but restricted to groin and periannal regions (U.S. *T. rubrum*)
- b. acute or chronic, often pruritic (itchy)
- c. lesions usually delimited w/ single raised erythematous margin (single ring)
- d. tendency of lesions to be dry & scaling
- e. associated with conditions of high humidity & abrasive clothing

Tinea Pedis - (athlete's foot)

- a. Ringworms of feet
 - b. U.S. *T. rubrum* & *T. mentagrophytes*
main agents; Europe *E. floccosum*
 - c. Types: 1. interdigital
2. vesicular
3. hyperkeratotic-erythrodermic
 - d. Treatment topical azoles or topicals & oral azoles or other antimycotics
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Tinea Manuum
(ringworm of the hands)

- a. often associated with patients with severe, puritic tinea pedis
- b. treatment the same as for tinea pedis

Tinea Unguium
(ringworm of toenails and fingernails)

- a. often occurs after injury to nail
- b. very common on feet w/ tinea pedis
- c. nail invasion into quick
- d. treatment with oral itraconazole (Sporonox^R) or terbinafin (Lamisil^R)

Subcutaneous Mycoses

Heterogeneous collection of generally primary (1^o) infections caused by a large variety of fungi and characterized by lesion development in the subcutaneous tissues at the site of traumatic implantation.

1. generally localized & chronic
2. spread along lymphatics, by autoinoculation, or by unknown mechanisms in normal hosts
3. sometimes spread hematogenously or otherwise in both compromised/noncompromised hosts*
4. primary pathogenic mycoses having severity related to interplays of fungal virulence and host defenses
5. agents are often somewhat rare soil saprophytes that tend to live on dead or dying plant materials
6. agents may or may not exhibit vegetative dimorphism or polymorphism
7. agents are mostly Fungi Imperfecti
8. many agents are thought to be related (septal structures, DNA analyses, etc.)**
9. most dematiaceous (melanized) agents thought to be Loculoascomycetes**,***
10. many possibly related agents associated with disease only in compromised hosts

*Only relatively small number of AIDS patients involved with some agents of these mycoses. Most cases in immunocompetent patients.

**DNA-based phylogenetic analysis is clarifying relationships

***unlike *Piedraia hortaei* and *Hortaea werneckii* these probably Loculoascomycetes II (Chaetothyriomycetidae/Eurotiomycetes).