## Tinea Pedis

| | |
|---|---|
| **1. Acute Vesicular** | T.mentagrophytes and sometimes E.floccosum |
| | Small vesicles, vesiculopustules and/or blisters typically seen near instep. |
| | *Treatment*: Topical anti-fungal |
| **2. Chronic Papulo-squ-amous** | T.ruburm, sometimes T.mentagrophytes |
| | Often assoc. with hereditary palmoplantar keratoderma |
| | Thick, boggy yellow to brown hyperkeratosis with peripheral scaling and/or fissures. |
| | Usually bilateral. Characterized by a moccasin-like distribution. Hands may be infected as well. most common pattern is for both feet and one hand to be involved. When both hands and feet are infected, T.mentagrophytes is the organism |
| | *Treatment*: Debridement, topical anti-fungal and urea based emollient. May need oral |
| **3. Chronic Interd-igital** | T.mentagrophytes and sometimes T.rubrum and E.floccosum |
| | Fissuring, scaling, and maceration in the toes spaces. |
| | Hyperhidrosis is typically the cause |
| | *Treatment*: Wash and DRY in between toes. Can use cotton balls to place in between toes to absorb moisture. Can use Drysol products for feet and shoes. Can use alcohol spray to dry out area. If wear boots, use boot dryer to prevent moisture. Use sprays not cream. If use cream, needs to be completely rubbed in. Clean shoes and change socks every day. |
| **4. Acute Ulcerative** | T.mentagrophytes and can be complicated by grm- bacteria |
| | Presents with maceration, weeping, and ulceration of the sole with assoc. white hyperkeratosis and odour |
| | Need to rule our secondary infection by bacterial cultures and gram stains. |
| | *Treatment*: Oral antibiotics and topical anti-fungal |

Most commonly caused by T. rubrum, T.mentagrophytes. E.floccosum

## Diagnosis of Mycological Conditions

| Clinical Presentation | |
|---|---|
| KOH micros-copic evaluation | Nail or skin clipped and placed in 10% KOH solution. Observe under microscope for septa and branching hyphae |
| Fungal Cultures | Sabouraud's dextrose agar most common fungal mediym |
| Biopsy | Only used when concerned about malignancy. Can be examined with periodic acid schiff |

Dermatophytes are group of fungi capable of colonizing keratinized tissues such as the stratum corneum, nails and hair. They use keratin as a source of nutrients.
Three Genera of Dermatophytes: 1) Micros-

## Deep Fungal Infections (cont)

## Echinocandins- Inhibitors of Fungal Wall Synthesis (cont)

porum 2) Trichophyton 3) Epidermophyton

## Deep Fungal Infections

| | |
|---|---|
| **Majocchi's Granuloma** | caused by T.rubrum |
| | Starts as a fungal folliculitis and spreads into the dermis where it forms an inflammatory nodule |
| | clinically, there is a erythematous plaque with indistinct borders and no central clearing |
| | Oral therapy is necessary |
| **Sporotrichosis** | Secondary to sporothrix schenckii |
| | introduced into the dermis traumatically from thorns or splinters with the conidia |
| | Happens in gardeners |
| | Starts as a papule that becomes a painless ulcer with a ragged undermined red border. May follow lymphatics so wont respond to a topical. |
| | Tx: potassium iodide PO, Amphotericine B IV, PO itraconazole or terbinafine |
| **Chromoblastomycosis** | Caused by species pf phialophora, fonsecaea and cladosporium |
| | Nodule develops and ulcerates followed by scales, crust and scarring and keloid formation |
| | Tx: local heat, same as for sporotrichosis. Need to consult with infectious disease specialist |

## Polyenes- Inhibitors of Fungal Membrane Stability

| | |
|---|---|
| **MOA of Nystatin:** | Binds to ergosterol and produced channels/pores that alter fungal membrane permeability -> leakage of cell contents -> cell death |
| Nystatin Cream | mitte: 15g or 30g tube or 450g jar, sig: apply to affected areas of skin on feet twice a day for four weeks |
| | uses: candida infections (and to lesser extent dermatophyte infections) of the skin and mucosa |

## Echinocandins- Inhibitors of Fungal Wall Synthesis

| | |
|---|---|
| **MOA** | Target fungal cell wall synthesis by inhibiting synthesis of B-(1,3)-D glucans (a key component in the fungal cell wall). Disruption of cell wall integrity -> osmotic stress -> lysis of fungal cell -> fungal cell death |
| **Ciclopirox** (Topical) | 1% cream, mitte: 45g tube sig: applied twice a day to affected areas of skin for 4 weeks. Good for dermatophyte and candida infections of the skin |
| | 1% lotion (loprox) mitte: 60ml bottle sig: applied twice a day to affected areas of skin for 4 weeks |
| | Nail Lacquer 8% (Penlac) mitte: 6.6ml bottle with brush applicator sig: apply once a day to all affected nails for 6-9 months. Remove build up with alcohol or nail polish remover every 7-10 days. Loprox and penlac are good for skin and nails |
| | *MOA*: Chelates metal ions in fungal membrane which increase fungal cell membrane permeability (inhibits membrane transfer system by interrupting na/K/ATPase) -> fungal cell death |
| | Effective against some bacteria |
| | exerts anti inflammatory activity by inhibiting 5-lipoxygenase and COX enzymes |
| **Tolnaftate** | topical: OTC powder (tinactin), gel and cream. unknown MO. Good for tinea versicolour and mild dermatophytes infections of skin |



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## Echinocandins- Inhibitors of Fungal Wall Synthesis (cont)

| | |
|---|---|
| **Undecycline Acid** | topical: OTC power (desenex), cream, spray (tolcylen) Unknown MOA. Used as preventative or adjunct. Uses: candida and mild dermatophyte infections of skin |

Routine debridement will help decrease fungal load and help with drug penetration !!

## Tinea Ungium/ Onychmycosis

| | |
|---|---|
| Caused by: | E.floccosum, T.rubrum, T.mentagrophytes |
| Toe nail infections may seem chronic and resistant to therapy due to: | 1. Footgear occlusion |
| | 2. Nail trauma |
| | 3. Decreased circulation |
| | 4. Endogenous re-infection |

## Other Fungal Infections

| | |
|---|---|
| **Candidiasis** | candida albicans is a yeast fungus |
| | *Clinical manifestations*: Intertrigo, OM, tinea pedis, folliculitis, paronychia |
| Candidal Paronychia | Treatment for 4-6 weeks w/ topical imidazoles, nystatin, ciclopirox or terbinafine |
| Tinea Versicolour | Caused by Malassezia furfur (yeast) |
| | characterized by hypopigmented and/or hyperpigmented macules w/ a fine scale localized to the trunk and thighs |

## Other Fungal Infections (cont)

Usually found in lipic rich areas and releases an acid that impacts melanin

Tx: topical azole cream/shampoo, terbinafine gel, selenium sulfide,cicloppirox

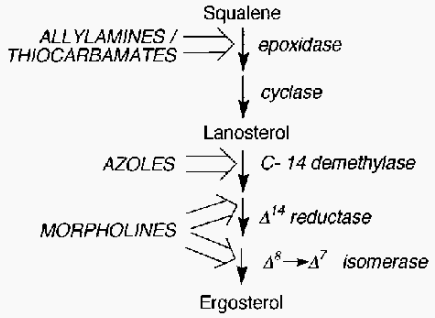
Oral Tx: fluconazole, itraconazole. Oral terbinafine is not effective

## PREVENTION

| | |
|---|---|
| 1. Keep skin intact (protected) | 2. Prevent excessive moisture- don't let skin get excessively wet, change socks and wet shoes. Dry thoroughly after shower |

3. Avoid contamination- wear shower shoes. Put socks on first, disinfect shoes and bathtub

## Inhibitors of the Ergosterol Synthesis Pathway




## Allylamines

| | |
|---|---|
| **MOA:** | Inhibit squalene epoxidase and prevents formation of lanosterol from squalene. lanosterol is needed for production of ergosterol which is needed for normal structure and function of plasma membrane. Accumulation of squalene which is a toxic metabolite will occur, making these drugs fungicidal |

## Allylamines (cont)

| | |
|---|---|
| *Oral Terbinafine* | Hepatic CYP metabolism, renal excretion (inactive). Highly lipid soluble so penetrates through nails. However, benefits do not outweigh risk for tx of OM. |
| | Pulse dosing is effective as it is less overall drug so better on liver and less costly |
| **Topical Terbinafine**: | 1% cream or gel or 1% spray, mitte: 15g or 30g, tube or 30ml for spray sig: apply to affected areas of skin on feet once or twice a day |
| | Uses: tinea pedis (dematophytes), tinea corporis, tinea cruris |
| **Oral Terbinafine**: | Daily dosing: 250mg tablets mitte: 84 tablets sig: one tablet po daily for 12 weeks (LFT and CBC baseline lab tests with repeat at 4-6 weeks) |
| | Pulse dosing: 250mg tablets, mitter: 42 tablets sig: two tables po daily for 1 week followed by 3 weeks off for three months then mitte 7 tablets sig: one tablet po daily for 7-21 days |
| | Uses: OM, tinea pedis(dermatophytes)/capitis/cruris/corporis, and systemic fungal and candida infections |



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## Allylamines (cont)

| | |
|---|---|
| | Contraindicated in pts with liver disease or renal impairment |
| | side effects: Hepatotoxicity, neutropenia, GI upset, skin reactions, taste/smell disturbances, renal and liver function impairment |
| **Allylamine Hepatotoxicity:** | increase in serum transaminase levels, symptomatic liver injury occurs rarely, majority of cases resolve within 3-6mos of stopping meds |
| **Allylamine Interactions** | warfarin and other CYP metabolism drugs, cimetidine, azole antifungals, TCAs, SSRI, beta blockers, opioids, MAO inhibitors, anti-arrythmics (ie digoxin), |

## Types of Onychomycosis

| | |
|---|---|
| **1. Distal Subungal Onychomycosis** | Most common OM and most common organism is T.rubrum |
| | Fungal penetrates distal hyponychium or lateral nail fold region |
| | Starts with subungual debris, yellowing and onycholysis |

## Types of Onychomycosis (cont)

| | |
|---|---|
| | After many years, keratinization of the distal nail bed occurs with loss of the nail grooves. Proximal nail plate then appears as a thick mound w/ neglected care, a ram's horn deformity develops |
| | non dermatophytes such as aspergillus niger can also cause OM (ddx is pseudomonas infection) |
| **2. Proximal Subungual Onychomycosis** | Occurs secondary to fungi entering the proximal nail fold and then the matrix and nail plate. |
| | infection involves the nail plate but the nail surface is intact |
| | Debris develops under nail plate then onycholysis. Nail appears white and fluid may accumulate under nail |
| **3. White Superficial Onychomyocosis** | Due to T.mentagrophytes |
| | Fungi infect the superficial nail plate. Nails are dry, soft, powdery white |
| | Topical may work early on as it is on the nail plate |
| **4. Candidal Onychomycosis** | Caused by candida albicans |

## Types of Onychomycosis (cont)

| | |
|---|---|
| | Nails are thick, white-yellow or yellow-brown |
| | entire nail plate is involved often with paronychia, inflammation and toe tip vesiculation |
| **Complications** | Permanent nal matrix or nail bed changes, subungual ulceration, secondary bacterial infection, possibly gangrene |

## Azoles

| | |
|---|---|
| **MOA**: | Inhibit 14a-sterol demethylase and prevent formation of ergosterol by preventing lanosterol conversion to ergosterol. Fungistatic |
| **Clotrimazole** (Topical) | 1% cream mitte: 15g or 30g tubes or 500g tub sig: apply to affected areas on feet twice a day for four weeks. |
| | Uses: superficial fungal and candida infections of stratum corneum and squamous mucosa (not good for hair and nails) |
| **Miconazole**(Topical) | 2% cream or 2% spray mitte: 30g tube or 85g cans for spray sig: apple to affected areas twice a day for four weeks |
| | uses: same as clotrimazole |



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| Azoles (cont) | |
|---|---|
| **Ketoco-nazole**(Topical) | 2% cream mitte: 30g tube sig: apply to affected areas once-twice a day for 4 weeks. |
| | uses: same as above |
| **Efinaconazole (Jublia)** (Topical) | 10% cream, applied daily to nails with no need to remove excess product |
| | uses: DLSO, AE: dermatitis and vesicles on application sites |
| | Gold standard for topical tx of OM |

-Azoles inhibit hepatic P450 enzymes therefore drug to drug interactions are an important consideration whenever they are used.
-Topical azoles are better for candida infections and are less expensive whereas allylamines are better against common dermatophytes but are more expensive

By **happyfeet2020**

cheatography.com/happyfeet2020/

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