Adult Cutaneous Fungal Infections I: Dermatophytes

Basic Dermatology Curriculum

Last updated November 27, 2013
Module Instructions

- The following module contains a number of blue, underlined terms which are hyperlinked to the dermatology glossary, an illustrated interactive guide to clinical dermatology and dermatopathology.
- We encourage the learner to read all the hyperlinked information.
Goals and Objectives

The purpose of this module is to help medical students develop a clinical approach to the evaluation and initial management of patients presenting with cutaneous fungal infections.

By completing this module, the learner will be able to:

• Identify and describe the morphologies of superficial fungal infections
• Describe the correct procedure for performing a KOH examination and interpreting the results
• Recognize the use and limitations of KOH examination and fungal cultures to diagnose fungal infections
• Recommend an initial treatment plan for an adult with tinea pedis, tinea corporis, and onychomycosis
Case One

Mr. Eugene Brown
Case One: History

- **HPI:** Eugene Brown is a 62-year-old healthy man who presents to his primary care physician with a one-year history of itching and burning of his feet.
- **PMH:** no chronic illnesses or prior hospitalizations
- **Medications:** none
- **Allergies:** no known allergies
- **Family history:** noncontributory
- **Social history:** lives with wife, goes to gym three times a week, works as a banker
Case One: Skin Exam

How would you describe these exam findings?
Case One: Skin Exam

Erythematous, scaling plaques on the plantar surface and between the toes
Case One, Question 1

Which of the following is Mr. Brown’s most likely diagnosis?

a. Atopic dermatitis
b. Candidal intertrigo
c. Onychomycosis
d. Psoriasis
e. Tinea pedis
Case One, Question 1

Answer: e

Which of the following is Mr. Brown’s most likely diagnosis?

a. Atopic dermatitis (Characterized by red patches and plaques ± scale. Lichenification may also result)

b. Candida intertrigo (Erythematous, eroded areas with satellite papules. Less likely location)

c. Onychomycosis (Fungal infection of the nail)

d. Psoriasis (The interdigital and plantar surfaces of the toes are unusual locations for psoriasis. Would expect a well-demarcated plaque with a thick silvery scale)

e. Tinea Pedis
Tinea Pedis: The Basics

- Tinea pedis ("athlete’s foot") is the most common fungal infection seen in developed countries
  - Most commonly caused by the fungus *Trichophyton rubrum*
- Fungus thrives in warm, moist environment (e.g., shoes)
- Public showers, gyms are common sources of infection
  - Good foot hygiene may reduce recurrences
- There are three clinical patterns of infection: interdigital, moccasin, and vesiculobullous type
Most common, presents with scaling and redness between the toes and may have associated maceration.
Tinea Pedis: Moccasin Type

- Also known as chronic hyperkeratotic type.
- Sharply marginated scale, distributed along lateral borders of feet, heels, and soles.
- Often associated with onychomycosis (fungal infection of the nails).
Tinea Pedis: Moccasin Type

- Moccasin type may present as “one hand, two feet” syndrome.
- Affected hand shows unilateral fine scaling in the creases.
- If you see a hand like this, look at the feet as well.
Tinea Pedis: Vesiculobullous Type

- Grouped, 2-3 mm vesicles, often on the arch or instep.
- May be itchy or painful.
- Often scale on the sole.
- Delayed hypersensitivity immune response to a dermatophyte.

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More examples of tinea pedis

- Moccasin
- Interdigital
- Vesicular
Case One, Question 2

Which of the following is the most appropriate next step in diagnosis?

a. Begin empiric treatment with antifungals
b. KOH (potassium hydroxide) exam
c. Skin biopsy
d. Wood’s light
Case One, Question 2

**Answer: b**
Which of the following is the most appropriate next step in diagnosis?

- a. Begin empiric treatment with antifungals (First need a diagnosis. There are many scaly eruptions that can occur on the foot)
- b. **KOH (potassium hydroxide) exam**
- c. Skin biopsy (Too invasive when a simpler test is available)
- d. **Wood’s light** (Organisms will not fluoresce)
KOH Exam: Basic Facts

- KOH microscopy is the easiest and most cost effective method used to diagnose fungal infections of the hair, skin, and nail.
- KOH dissolves keratinocytes; easier to see hyphae
- Proper technique requires training
  - Sensitivity is dependent on the operator’s experience.
  - Heat may be used to accelerate this reaction
  - Chlorazol black in KOH prep helps as well
The KOH Exam Procedure

1. Clean and moisten skin with alcohol swab
2. Collect scale with #15 scalpel blade
3. Put scale on center of glass slide
4. Add drops of KOH and coverslip; heat slide gently or wait 10 minutes
5. Microscopy: scan at 10X to locate hyphae; then study in detail at 40X if needed

Click [here](#) to watch the video
Make sure to turn on your computer volume (video length 8min 41sec)
What are the diagnostic features in this KOH exam?

Magnification 40x
Case One: KOH Exam

What are the diagnostic features in this KOH exam?

- Parallel walls throughout the entire length
- Septated and branching hyphae

Magnification 40x
Limitations of KOH prep

• False negative due to prior partial treatment with antifungals
  – Please do not start antifungals then consult dermatology and ask if it is a fungus.
• Not obtaining enough sample
• Inexperience of person reading the slide
KOH exam

• If you do not have the experience to read a KOH slide, you may collect a sample of fine scale (about 1/8 teaspoon) and submit it in a sterile specimen cup for the lab to analyze.
Case One, Question 5

Which of the following would be the best choice for initial treatment?

a. Bacitracin ointment 3 times daily for 4 weeks
b. Clotrimazole cream twice daily for 4 weeks
c. Nystatin cream twice daily for 4 weeks
d. Oral terbinafine 250 mg daily for 3 months
Case One, Question 5

Answer: b

Which of the following would be the best choice for initial treatment?

a. Bacitracin ointment 3 times daily for 4 weeks (antibiotic, not antifungal)

b. Clotrimazole cream twice daily for 4 weeks

c. Nystatin cream twice daily for 4 weeks (only treats Candida yeast, not dermatophytes)

d. Oral terbinafine 250 mg daily for 3 months (side effects and cost not justified for limited tinea pedis; also this dosing is for onychomycosis)
Treatment of Tinea Pedis: Hygiene

- For all types of tinea pedis, **hygiene** and **topical antifungals** are effective therapies
- **Hygiene:**
  - Dry the area after bathing
  - Change socks daily and alternate shoes worn
  - Consider wearing open shoes such as sandals
  - Use antifungal foot powder (available over the counter) to keep feet dry
Antifungals for Tinea Pedis

- **First-line therapy: imidazoles (fungistatic)**
  - Clotrimazole or miconazole cream apply to affected areas twice daily for 4-6 weeks

- **Second-line therapy: allylamines (fungicidal)**
  - Terbinafine, naftifine, or butenafine cream or gel once or twice daily (product dependent) for 4-6 weeks
  - Allylamines have better sustained cure rates than imidazoles but are often more expensive.

- Prescribe 30-45 grams to cover both soles twice daily for a month.
When to Refer

• Tinea pedis, corporis, or cruris that has failed to respond to hygiene changes, imidazole, and allylamine therapy
• Large body surface area involved
• Involvement of atypical areas of the body may indicate alternative diagnoses that need to be evaluated by the dermatologist
Case Two

Mr. Daniel Green
Case Two: History

- **HPI:** Daniel Green is a healthy 18-year-old who presents with a lesion on his right leg that has been present for 2 weeks. The lesion is slightly itchy and is growing in size.
- **PMH:** no major illnesses or hospitalizations
- **Medications:** none
- **Allergies:** none
- **Family history:** noncontributory
- **Social history:** Lives with his parents and sister. The family adopted a puppy 3 months ago. No history of recent travel.
Case Two: Skin Exam

How would you describe these exam findings?
Case Two: Skin Exam

This is a sharply marginated, erythematous annular plaque with central clearing and scaling at the edges.
KOH is positive. Which of the following is the most likely diagnosis?

a. Atopic dermatitis
b. Psoriasis
c. Seborrheic dermatitis
d. Tinea corporis
e. Tinea cruris
Answer: d

Which of the following is the most likely diagnosis?

a. **Atopic dermatitis** (Poorly defined erythematous patches without central clearing)

b. **Psoriasis** (Well-demarcated erythematous plaques with silvery scale, without central clearing)

c. **Seborrheic dermatitis** (Inflammatory reaction to yeast typically affecting face, chest, and/or scalp, often with scaling; see The Red Face module to learn more)

d. **Tinea corporis**

e. **Tinea cruris** (Dermatophyte infection in the groin)
Tinea corporis, “ringworm”, refers to dermatophytosis of the skin, usually affecting the trunk and limbs

- Often itchy
- The margin of the lesion is the most active; central area tends to heal
- Scrapings should be taken from the red scaly margin for KOH exam
- A variant of this is tinea cruris or “jock itch”, which has a similar presentation but appears in the groin
- Check the bottom of the feet for tinea pedis
Tinea Corporis

Annular lesion with central clearing is typical of tinea corporis
More examples of tinea corporis
Tinea cruris

- Dermatophyte infection of the groin is called tinea cruris (aka “jock itch”)
- May lack scale because of scrotal occlusion
- Look at the soles for tinea pedis
Why Perform A Fungal Culture?

- Tinea corporis may be caused by different fungal species with different environmental sources
  - Fungal culture can help identify the source and guide treatment
  - Ask your lab how to submit the fungal culture. You may be able to submit skin scrapings in a sterile specimen container and have the lab plate it for you.
Tinea Corporis: Treatment

- **Topical antifungals** are applied until tinea shows resolution, then continue treatment for a minimum of two weeks; this usually takes 4-6 weeks total
  - Imidazoles (clotrimazole, miconazole) are first-line
  - Allylamines (naftifene, terbinafine, butenafine) are second-line unless cheaper at your institution than imidazoles

- **Oral antifungals** are indicated if:
  - Poor response to topical agents, an animal is the suspected source of infection, or large surface area involved
  - Fungal culture can help guide therapy
  - Terbinafine daily for 7-14 days
    - Check liver function tests if giving more than 7 days
    - Discuss and monitor for side effects and drug interactions
Case Three

Mr. Michael White
Case Three: History

- **HPI:** Michael White is a healthy 54-year-old who presents with thickening of several toenails that did not improve with topical miconazole cream nor an over-the-counter mentholated vapor rub.
- **PMH:** no major illnesses or hospitalizations
- **Medications:** atorvastatin
- **Allergies:** none
- **Family history:** mother with psoriasis
- **Social history:** Retired firefighter and part-time swimming coach. Lives with his second wife.
Case Three: Skin Exam

How would you describe these exam findings?
Case Three: Skin Exam

- Nail thickening and subungual debris
- Additional exam
  - Multiple toenails involved
  - Also scaling on soles bilaterally
  - Rest of full body skin exam is normal
Case Three, Question 1

What is the best test to order at this time?

a. Clinical diagnosis is sufficient
b. Fungal culture of subungual debris
c. Hepatitis C antibodies
d. HIV 1 and 2 antibodies
e. Punch biopsy of nail plate and bed
Case Three, Question 1

Answer: b

What is the best test to order at this time?

a. Clinical diagnosis is sufficient (low specificity; often not fungus; need confirmation of fungus!)

b. **Fungal culture of subungual debris**

c. Hepatitis C antibodies (associated with lichen planus, not onychomycosis)

d. HIV 1 and 2 antibodies (not indicated for distal subungual onychomycosis)

e. Punch biopsy of nail plate and bed (too invasive for first test; fungal culture is better)
Onychomycosis

- Onychomycosis is a chronic fungal infection of the nailbed
- Usually starts with tinea pedis
- Responds very poorly to topical antifungals
Onychomycosis

- Most common type is distal subungual onychomycosis (DSO)
  - Thickened nail, subungual debris, and separation of the nail plate from nail bed
  - Usually caused by dermatophyte *Trichophyton rubrum*
- Superficial white onychomycosis (SWO) is less common and may respond to topical therapy
- Proximal subungual onychomycosis (PSO) may herald immunosuppression
Distal subungual onychomycosis
Onychomycosis

- Confirmation of fungus in the affected nail is necessary before oral antifungal treatment
  - May mimic other conditions (e.g. psoriasis)
- Methods for confirming fungus:
  - Fungal culture is preferred because identification of organism can help direct therapy
  - KOH exam of fine curetting of subungual debris
  - Nail clippings or nail biopsy submitted for histologic exam with fungal stains
The fungal culture comes back three weeks later, positive for *Trichophyton rubrum*. What is the best treatment?

a. Ciclopirox nail lacquer  
b. Clotrimazole cream  
c. Oral fluconazole  
d. Oral nystatin  
e. Oral terbinafine
Case Three, Question 2

Answer: e

The fungal culture comes back three weeks later, positive for *Trichophyton rubrum*. What is the best treatment?

a. Ciclopirox nail lacquer (poor efficacy compared to oral antifungals)
b. Clotrimazole cream (poor efficacy)
c. Oral fluconazole (inferior to terbinafine)
d. Oral nystatin (only works on *Candida* yeasts)
e. Oral terbinafine
Distal Subungual Onychomycosis
Treatment

First-line treatment

- Terbinafine 250 mg daily for 12 weeks
- Risks: idiosyncratic hepatotoxicity, reversible taste disturbance, drug interactions (P450 CYP2D6 inhibitor), skin reactions
  - Must counsel patients on risks and monitor liver function
  - Do not begin treatment without confirmation of fungus on culture, KOH, or histologic exam
- Clinical cure only seen in 50% of patients, so treatment failure is a significant risk
Distal subungual onychomycosis treatment

• Second-line therapies
  – Itraconazole
  – Fluconazole
• These may be helpful in DSO caused by non-dermatophyte molds or yeast
• Obtain positive fungal culture to identify organism before initiating second-line therapies
• Review Roberts BMJ article in references
When to refer

- Nail dystrophy that is negative on multiple fungal cultures and/or histology
  - Only half of nail dystrophy is caused by fungus
- Patterns of nail dystrophy not typical for fungal infection, especially if other rashes are present
- Culture-positive onychomycosis that fails compliant first-line therapy

This patient has lichen planus, not onychomycosis
## Summary: Adult Fungal Treatment

<table>
<thead>
<tr>
<th>Condition</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; line</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; line</th>
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<tbody>
<tr>
<td>Tinea pedis Tinea corporis Tinea cruris</td>
<td>Clotrimazole or Miconazole cream</td>
<td>Terbinafine Naftifene Butenafine cream or gel</td>
</tr>
<tr>
<td>Onychomycosis (confirmed on fungal culture as dermatophyte)</td>
<td>Oral terbinafine</td>
<td>Oral fluconazole or itraconazole</td>
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Take Home Points

- Cutaneous fungal infections are extremely common.
- There are three clinical patterns of tinea pedis infection: interdigital, moccasin, and vesiculobullous type.
- If it scales, scrape it! KOH examination is the easiest and most cost effective method used to diagnose fungal infections of the hair, skin, and nails.
- Fungal culture is helpful in tinea corporis when the source of infection is not obvious (as opposed to tinea pedis)
Take Home Points

- Topical treatment is usually appropriate as a first-line agent for tinea pedis, tinea corporis, and candidal intertrigo, however oral medications are called for when involvement is extensive, when tinea corporis is thought to have been transmitted by an animal, and in fungal infections of the nails.

- Positive fungal culture is recommended prior to initiating oral antifungal treatment for onychomycosis.

- Monitor liver function tests when starting oral antifungals.

- Fungal infections have high rates of recurrence after treatment, but maintaining a dry, clean skin environment is helpful for prevention.
Acknowledgements

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References


To take the quiz, click on the following link:

https://www.aad.org/quiz/adult-fungal-learners