CHAPTER 38

Fungal Skin Infections

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Residents and travelers experience a variety of fungal infections of the skin. Many are not unique to the travel location, but the heat and humidity of the tropical environment increases susceptibility to these infections. In addition, inoculation with endemic fungal pathogens can result in deep fungal infections of the skin and subcutaneous tissues. In some cases presentation is delayed until travelers have returned to their home country.

Fungal infections of the skin (mycoses) are broadly divided into superficial and subcutaneous, based on the depth of involvement in the skin. Etiologies vary by presentation.

SUPERFICIAL CUTANEOUS MYCOSES

Superficial cutaneous mycoses invade the outer layer of skin (stratum corneum), hair, or nails. Dermatophytes and *Candida* species are the primary organisms responsible for the superficial mycoses, and immune response of the host may be minimal.

Dermatophyte Infections (Dermatophytoses)

Dermatophyte infections are due to fungal species in three genera: *Trichophyton*, *Microsporum*, and *Epidermophyton*. Worldwide, *Trichophyton rubrum* is the most common cause of dermatophyte infection, but in many instances the same clinical presentation can be caused by dermatophytes from different genera.

Epidemiology

The epidemiology of dermatophyte infection is different for each clinical presentation and geographic area. For example, tinea pedis and nail infections are uncommon before puberty, whereas tinea capitis is primarily a disease of childhood. Dermatophyte infections are enhanced by heat and humidity, and travelers to the tropics may note an exacerbation of a pre-existing infection. Sources of dermatophyte infection include soil, animal reservoirs, and human-to-human transmission.

Clinical Features

Tinea capitis, or "ringworm" of the scalp, is mainly a disease of children caused by *Microsporum* or *Trichophyton* species. *Trichophyton tonsurans*, *Microsporum canis*, *and Microsporum audouinii* are most common.

The condition presents with hair loss (alopecia), usually with scale. Patchy areas of broken hairs covered by white scales can resemble seborrheic dermatitis. When tinea capitis invades the hair shaft the scalp shows a characteristic "black-dot" pattern, in which hairs broken off at scalp level resemble comedones within patches of alopecia. Lymphadenopathy is frequently present and can help differentiate from non-infectious causes of hair loss.

Inflammatory tinea capitis occurs in the setting of tinea infection coupled with a brisk host inflammatory response. A boggy inflamed plaque (kerion) may form, which is associated

with systemic symptoms, including fever, pain, and regional lymphadenopathy. Permanent hair loss may occur.

Tinea favosa (*favus*) is a special type of chronic and progressive inflammatory infection on the scalp most frequently caused by *Trichophyton schoenleinii*. This variant is seen in Asia, Africa, the Middle East, and South America. It is characterized by permanent hair loss and inflammation of the scalp, which becomes covered by matted hair with dense, yellow, follicular, cup-shaped crusts (scutula) that have an unpleasant odor.

Tinea corporis, or "ringworm," affects all ages and is recognized by annular, thin plaques, with erythema and scale most prominent at the advancing border (**Fig. 38.1**). Lesions spread outward with central clearing. There may be multiple areas involved, but widespread involvement is unusual. The plaques vary in size from a few millimeters to many centimeters in diameter. Pruritus is variable. In some cases there is follicular involvement presenting with papules and pustules, especially at the advancing border. Differential diagnosis of tinea corporis includes psoriasis, nummular eczema, pityriasis rosea, subacute cutaneous lupus, and secondary syphilis.

Tinea imbricata is an unusual variant of tinea corporis caused by *Trichophyton concentricum* that is endemic in the South Pacific, Southeast Asia, and Central and South America. This presentation is chronic and results in the development of multiple large, loosely adherent scales covering large areas of the body that coalesce to form lacy concentric patterns similar to wood grain.

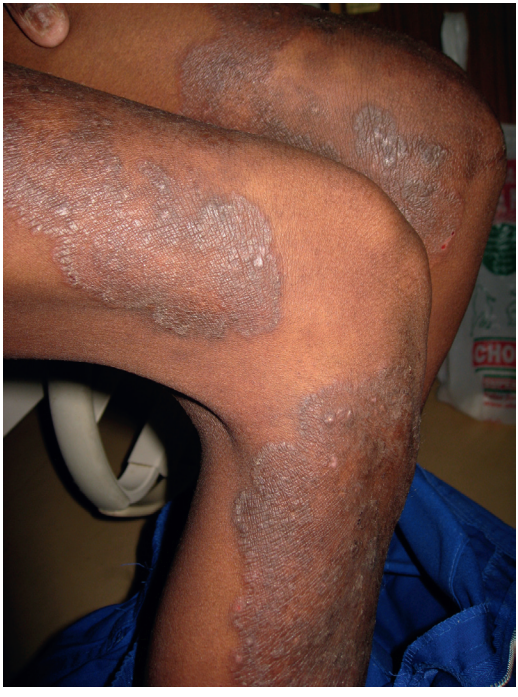

Fig. 38.1 Sharply demarcated plaques with central clearing and accentuation of the advancing border in tinea corporis. (Courtesy of Nicholas Compton MD.)

Tinea cruris, or "jock itch," usually occurs in adult males and may be accompanied by tinea pedis. It is caused by *Epidermophyton floccosum*, *Trichophyton rubrum*, or *Trichophyton mentagrophytes*. The infection begins as an erythematous scaling patch involving intertriginous areas of the groin folds and inner thighs. Although it may extend on the lower abdomen and gluteal region, the scrotum is usually spared. There is mild erythema, with a well-demarcated scaly border. Differential diagnosis includes seborrheic dermatitis, erythrasma, intertrigo, candidiasis, and psoriasis.

Tinea pedis, or "athlete's foot," is the most common location for dermatophyte infections. Clinical variants of tinea pedis include maceration and scale of the interdigital spaces and mild diffuse erythema and scale of the foot in a moccasin distribution. A vesicular presentation with 1-2 mm dried vesicles of the plantar surface, commonly on the mid foot, may occur. Differential diagnosis includes contact dermatitis and psoriasis.

Onychomycosis, or dermatophyte infection of the nail, results in nail plate thickening, dystrophy, and subungual debris of one or several nails. Toenails are affected more often than fingernails. Many organisms may cause onychomycosis, including nondermatophytes. When dermatophytes are the culprit, then concurrent tinea pedis is usually the source of the nail infection. Differential diagnosis includes psoriasis, lichen planus, candidiasis, and hereditary nail dystrophies. In diabetic individuals dermatophyte infections of the nails and feet create a portal of entry for bacterial infections, putting them at risk for cellulitis, especially due to streptococci.

Diagnosis

In all forms of dermatophyte infection, diagnosis rests on demonstrating the fungus, either by KOH examination of scrapings or by culture. The KOH examination is a simple, rapid diagnostic tool. A sample is taken of scale at the active border of skin lesions, of subungual debris in onychomycosis, or of hairs in tinea capitis. The sample is placed on a microscope slide, covered with a few drops of 10-20% KOH and a coverslip, then heated briefly to lyse keratinocytes and reveal the KOH-resistant fungal structures. The specimen is examined for hyphae using the ×10 objective with the condenser lowered. Culture for dermatophytes often requires 2-6 weeks' growth to identify the fungal species.

Treatment

Topical therapy

Topical therapy is usually adequate for tinea pedis, tinea cruris, and limited forms of tinea corporis. Topical agents include imidazoles (clotrimazole, miconazole, ketoconazole, and econazole), the allylamine terbinafine, and other agents (ciclopirox, naftifine, and tolnaftate). These agents are usually applied as creams twice daily until clearing occurs. Avoid topical steroid use in these conditions, as it can worsen infection.

Systemic therapy

For tinea capitis, oral treatment is required; griseofulvin is effective therapy. The newer antifungals terbinafine, itraconazole, and fluconazole have been shown to be efficacious and safe alternatives to griseofulvin.

- Griseofulvin single or divided daily dose, 20 mg/kg/day for 6-12 weeks
- Terbinafine: patient weight >35 kg, 250 mg/day for 2-4 weeks; patient weight <25 kg, 125 mg/day for 6 weeks
- Itraconazole: 5 mg/kg per day for 4-6 weeks or pulse dosing of 5 mg/kg per day for 1 week each month for 2-3 months.

Duration of therapy with these agents is adjusted based on clinical response. Adjunctive use of antifungal shampoos (selenium sulfide or ketoconazole) often hastens the clinical response and may help prevent spread of infection to others.

Systemic therapy is indicated for recalcitrant or widespread tinea corporis, cruris, and pedis. The following regimens (adult doses) have been used:

- Terbinafine: 250 mg daily for 2 weeks
- Fluconazole: 50-100 mg daily or 150 mg once a week for 2-3 weeks

- Itraconazole: 100 mg daily for 2 weeks or 200 mg daily for 7 days.

Onychomycosis is treated systemically. The following regimens have been used:

- Terbinafine: 250 mg/day for 6 weeks in fingernails and 12 weeks in toenails
- Itraconazole: 200 mg orally twice a day for 7 days/month for 3 months for toenails (two pulses for fingernails) or 200 mg orally daily for 12 weeks
- Fluconazole: 150-200 mg orally weekly for 9 months for toenails (6 months for fingernails).

The imidazole antifungals (ketoconazole, itraconazole, and fluconazole) have significant drug interactions; review the patient's medications for conflicts before prescribing.

Tinea Nigra

Tinea nigra is an uncommon superficial mycosis, often grouped with the dermatophytes, but caused by the melanin-producing dimorphic yeast *Hortaea werneckii*. The organism lives in soil, sewage, decaying vegetation, and also has been found on shower stalls in humid environments.

Epidemiology

Tinea nigra is a rare condition found in warm and humid climates, thought to be contracted from soil or decaying vegetation. The disease has been reported mainly in Central and South America, although cases have been identified in the southern United States, Africa, and Southeast Asia. Inoculating the organism into the skin with minor trauma has produced experimental infections, and this is believed to be the probable mechanism for natural infection. Lesions slowly develop over years and have been observed in travelers to endemic areas.

Clinical Features

The typical lesion is a well-demarcated, asymptomatic, brown to black patch of the palmar or plantar skin, resembling a stain. The lesions may resemble junctional nevi or acral lentiginous melanoma; however, the pigment may be partly removed by shaving off the most superficial stratum corneum layer of the skin. It occurs most commonly on the palms, but feet and other areas can be involved.

Diagnosis

KOH preparation of skin scrapings reveals hyphae. If a skin biopsy is done, the pigmented organisms can be seen in the stratum corneum.

Treatment

Tinea nigra is effectively treated with twice daily applications of imidazole or ciclopirox. Topical tolnaftate and oral griseofulvin are reported to be ineffective.

Conditions Caused by *Malassezia*

Malassezia furfur and *Malassezia globosa* are lipophilic fungi and part of the normal human microbiome. It is believed they play a pathogenic role in several dermatologic conditions, including seborrheic dermatitis, tinea (pityriasis) versicolor, and *Malassezia* (*Pityrosporum*) folliculitis. The latter two conditions are discussed here.

Tinea Versicolor

Tinea versicolor (pityriasis versicolor) is a common, usually asymptomatic superficial fungal infection that thrives under conditions of warmth and increased moisture.

Epidemiology

It is primarily a condition of adolescents and young adults, although those of any age may be affected. In some tropical populations, prevalence may exceed 50% among young adults. Infection is believed to reflect changes in host flora, and therefore person-to-person transmission is thought not to occur. Travelers to the tropics may experience their first episode of tinea versicolor.

Clinical features

The lesions of tinea versicolor are round or oval macules that coalesce into larger patches. They have a fine scale that sometimes is evident only when the lesion is scraped during the physical examination. In untanned Caucasians lesions may be subtly fawn brown and go unnoticed. The yeast blocks melanin synthesis in the skin and also produces a skin bleaching agent. With ultraviolet exposure a hypopigmented spotted appearance is enhanced due to contrast with the darkened surrounding skin (**Fig. 38.2**). Lesions are typically distributed over the shoulders, chest, and back, and occasionally on the neck. Pruritus is usually absent.

Diagnosis

In tinea versicolor, the clinical presentation is often sufficient to make the diagnosis. A KOH examination of scale scraped from lesions invariably shows the organisms and confirms the clinical suspicion. They are seen as short, curved hyphae and spherical yeast, giving a characteristic "spaghetti and meatballs" appearance.

The ease of confirming the diagnosis makes differential diagnosis less important. However, the appearance of hypopigmented lesions in the tropics may raise concerns of Hansen's disease (Chapter 40), in which hypopigmented lesions are anesthetic, or vitiligo, in which the lighter areas are not covered by scale and are completely depigmented rather than merely lighter in color.

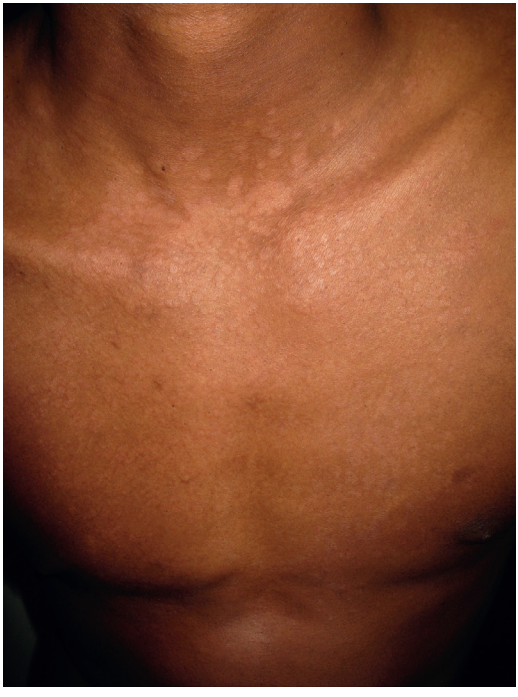

Fig. 38.2 Hypopigmented and slightly pink macules on the chest in tinea versicolor. (Courtesy of Nicholas Compton MD.)

Treatment

Topical

Many topical medications are effective in treating tinea versicolor, but recurrence is common. Even after successful treatment, pigment changes often take several months to return to normal. The following treatment regimens have been used successfully:

- 2.5% selenium sulfide shampoo: applied to affected areas for 10-15 min, then rinsed off. The application is repeated two times per week for 2-4 weeks.
- Various azole antifungal creams or lotions, including ketoconazole, miconazole, econazole, clotrimazole, and terbinafine: twice daily for 2 weeks.
- Oral treatment is sometimes required when topical therapy is impractical and success with multiple approaches is reported. One regimen is fluconazole 300 mg per week for 2 weeks.

Pityrosporum (Malassezia) *Folliculitis*

Pityrosporum folliculitis is a pruritic, follicular eruption caused by *Malassezia* spp. This disorder thrives in warm, humid climates especially on areas of the body covered by occlusive clothing. On biopsy prominent follicular dilation and inflammation is seen, owing to increased colonization with the fungi.

Epidemiology

Malassezia folliculitis usually affects young adults from the post-pubertal teens to the mid-30s, although it has been reported in children and the elderly. Predisposing factors include immunosuppression, corticosteroid therapy, and diabetes.

Clinical features

In temperate climates, *Malassezia* folliculitis characteristically presents as multiple monomorphic, pruritic, follicular papules and pustules distributed about the chest, upper back, and occasionally the proximal extremities.

Diagnosis

Diagnosis is best made by demonstrating the yeast in the follicular plug from one of the papules by direct microscopy using either 10-20% KOH or Gram stain. Serial sections of punch biopsies stained for fungi will also reveal numerous yeast forms in dilated follicles, but this is rarely necessary.

The differential diagnosis includes other types of folliculitis, including bacterial (staphylococcal) and candidal folliculitis, and acne vulgaris. Gram stain of an unroofed pustule helps to differentiate *Malassezia* folliculitis from other folliculitides. Acne vulgaris rarely has the prominent pruritus associated with the *Pityrosporum* folliculitis.

Treatment

Many topical regimens have been used effectively; there is no consensus on the best regimen. Adjunctive oral therapy is usually reserved for widespread cases or those unresponsive to topical therapy. The following regimens have been used successfully, although recurrences are common:

- 2.5% selenium sulfide shampoo: applied to affected areas for 10-15 minutes, then rinsed off. The application is repeated two times per week for 2-4 weeks.
- Various azole antifungal creams or lotions, including ketoconazole, miconazole, econazole, clotrimazole, and terbinafine: twice daily for 2 weeks.
- Itraconazole: 200 mg daily for 7 days.

Cutaneous Candidiasis

Candida albicans is part of the normal human mucosal flora. Under certain conditions and given various predisposing host factors, *C. albicans* and other less common species of *Candida* may become pathogenic, giving rise to several distinct clinical diseases. In addition to mucosal infections, candidiasis can occur as a cutaneous-only infection and as a systemic infection with cutaneous findings. Mucosal and cutaneous candidiasis are discussed here.

Epidemiology

The various clinical presentations of cutaneous candidiasis are quite common, with the greatest prevalence in newborns and elderly persons. In tropical climates, increased temperature and humidity, coupled with occlusive clothing, predispose travelers to cutaneous candidal infections. Other associated risk factors include diabetes, immunosuppression, corticosteroid therapy, and antibiotic use.

Clinical features

Oral candidiasis presents as "thrush" with white to gray, curd-like pseudomembranes overlying a shiny, brightly erythematous, painful mucosal surface on the buccal mucosa, palate, tongue, or gingivae. Differential diagnosis includes leukoplakia, in which the white mucosal plaques cannot be dislodged, and retained food particles that lack the underlying tenderness and erythema.

Less common oral presentations include the following:

- *Acute atrophic glossitis*: tender, shiny erythema of the dorsal surface of the tongue with loss of the normal papillae, seen most commonly in the setting of antibiotic or corticosteroid use.
- *Angular cheilitis* (*perlèche*): painful fissuring and erythema at the commissures of the lips.

Candidal vulvovaginitis occurs commonly in women and presents as a thick, white, vaginal discharge, often with associated pruritus, burning, and dysuria. The skin of the vulva often shows bright confluent erythema with scale and satellite papules and pustules. Speculum examination of the vaginal vault reveals brightly erythematous patches of vaginal mucosa with a "cottage cheese"-like vaginal discharge. Vulvovaginal involvement may extend to involve the perineum and crural folds, resulting in candidal intertrigo. *Candidal balanitis* usually occurs in uncircumcised men as confluent areas of moist, bright erythema with slight scale on the glans and prepuce. Candidal balanitis may spread to involve the scrotum and crural folds.

Candidal intertrigo is a common condition occurring in closely apposed skinfolds where there is a microenvironment of increased heat, humidity, and friction. Bright red, moist erythematous patches, usually with slight peripheral scale and satellite papules and pustules, occur symmetrically in the skin folds of the axillae, in the inframammary area, beneath the abdominal pannus, in the intergluteal fold, or in the crural folds. In infants, the skin folds of the anterior neck can be involved. Obesity, occlusion of the skin, and diabetes mellitus are common predisposing factors. Differential diagnosis includes psoriasis and seborrheic dermatitis, which should have findings consistent with these diagnoses in other areas. Tinea infection can involve the crural folds and would be distinguished by long, septated hyphal elements without yeast forms on KOH examination. Erythrasma, a bacterial infection caused by *Corynebacterium minutissimum*, has dull, red-brown, well-demarcated patches with fine scale; lacks satellite lesions and fungal elements on KOH scrapings; and shows a characteristic coral red fluorescence on Wood's lamp examination.

Diagnosis

Diagnosis can often be made clinically, but KOH examination of scrapings from mucosa or skin shows characteristic budding yeast cells and pseudohyphae. Culture is rarely necessary.

Treatment

All uncomplicated cutaneous candidiases respond well to most topical agents, including nystatin and azole antifungals. These agents come in various forms, including solutions, lotions, creams, powders, tablets, and troches. Creams and powders work well for intertrigo; measures to reduce occlusion and friction help prevent recurrence. Tablets and troches are best suited for oral candidiasis. Although topical agents work quite well for vulvovaginal candidiasis, fluconazole as a 150-mg, one-time oral dose is often used and preferred by patients.

It is important to search for and treat any underlying illness. The presence of oral thrush in an otherwise healthy individual should prompt an investigation of human immunodeficiency virus risk factors and appropriate testing when indicated.

Piedra

Piedra is a superficial fungal infection of the hair shaft seen most commonly in tropical climates. It presents in two distinct clinical varieties, black piedra and white piedra, caused by *Piedraia hortae* and *Trichosporon* species, respectively.

Epidemiology

Black piedra occurs in the tropical regions of the Americas and Southeast Asia. White piedra has a broader distribution, including Africa, Europe, and Japan. Both types show equal age and sex distribution.

Clinical features

Black piedra presents as asymptomatic, microscopic to 1 mm or larger, dark, firmly adherent, concretions on hair shafts of the scalp or, less commonly, the beard. White piedra also presents as asymptomatic concretions or nodules on the hair shafts, although these are lighter in color (white to light brown) and can be easily detached, unlike those of black piedra. White piedra involves facial and genital hair more often than scalp hair. In both forms, affected hair shafts may be weakened and fracture easily.

Diagnosis

Clinical inspection of the hair shafts and demonstration of fungal elements on KOH examination make the diagnosis in both forms of piedra. Culture of the organism can be problematic, so communication with the laboratory may aid in the accuracy of diagnostic testing.

Differential diagnosis includes lice (see Chapter 37), seborrheic dermatitis, trichomycosis axillaris, and inverse psoriasis. In trichomycosis axillaris, a benign infection of axillary or pubic hair by *Corynebacterium* species, yellow-tan deposits form on hair shafts. This disorder may be difficult to distinguish visually from white piedra, but KOH examination of the hair deposits will demonstrate the hyphae of *Trichosporon* in white piedra.

Treatment

Piedra is readily treated by cutting or shaving the affected hairs. Ketoconazole shampoo is an adjunctive treatment. In persistent cases oral itraconazole and terbinafine have been tried. *Trichomycosis axillaris* responds to topical clindamycin or benzoyl peroxide.

SUBCUTANEOUS MYCOSES

Subcutaneous mycoses are a group of uncommon localized fungal infections of the deep tissues caused by several species of fungi. These infections are seen mainly in the tropics and are thought to arise after endemic fungal organisms are directly implanted into the skin from a puncture wound or following an abrasion. Included in this group are chromoblastomycosis, mycetoma, sporotrichosis, and lobomycosis.

Chromoblastomycosis

Chromoblastomycosis (or "chromomycosis") is a chronic fungal infection of the skin and subcutaneous tissue caused by any of several pigmented fungi normally found in soil and wood, including species within the genera *Fonsecaea*, *Cladophialophora*, and *Phialophora*. These organisms are pigmented molds that produce identical clinical infections, and all appear in tissue sections as small (4-6 μm), brown-colored spherical forms, hence the name *chromo*blastomycosis. They can be distinguished in culture.

Epidemiology

Chromoblastomycosis occurs worldwide but is most common in tropical areas of the Americas, Africa, and Asia. It is also regularly reported in Japan and Australia. The majority of cases occur in male farm workers in rural areas. Persons of all ages may be affected, but most cases occur in adults.

Clinical Features

Lesions typically begin as a unilateral, solitary, warty nodule, most often on the limbs (especially lower leg or foot), which evolves slowly to a large tumorous plaque that ulcerates. Satellite lesions occur around the primary lesion and may form along lymphatic channels. Lesions are frequently exophytic and friable, with lobulated, keratotic surfaces. The disease progresses slowly over many years and may involve an entire extremity. Local edema of the extremity often appears, with secondary bacterial infection and lymphadenitis. Pain is uncommon in the absence of bacterial infection. Untreated infections may persist more than 20 years. In rare cases, dissemination occurs with central nervous system (CNS) or visceral involvement.

Diagnosis

The diagnosis of chromoblastomycosis rests on demonstrating the causative organism on histologic sections with confirmation of the pathogenic species by culture. Biopsy for histology and culture should be taken from the active border of a lesion. Histology shows a nonspecific granulomatous and neutrophilic response and often the pigmented organisms ("copper pennies" known as "Medlar bodies"), which are diagnostic. Culture often takes 2-4 weeks. Serologic tests are not helpful.

Differential diagnosis includes other granulomatous processes, such as sporotrichosis, leishmaniasis, blastomycosis, and leprosy. Rarely, chronic lesions can undergo malignant transformation to squamous cell carcinoma.

Treatment

Chromoblastomycosis is not reliably responsive to medical therapy. With early treatment, cure can be achieved, but in advanced disease relapses are expected. Optimal treatment for the disease is still debated, but extended courses of itraconazole, terbinafine, and posaconazole have been used.

- Itraconazole: 200-400 mg/day
- Terbinafine: 250-1000 mg/day
- Posaconazole: 800 mg/day.

Amphotericin B and fluconazole are ineffective, and ketoconazole is not recommended due to toxicity with prolonged treatment. Treatment is lengthy with courses of 6-12 months, and drug resistance may develop during therapy. Combinations of multiple drugs, or drug therapy combined with physical approaches such as cryotherapy, application of heat, and ALA-PDT, are used with some effectiveness. Surgical approaches can be considered if the lesions are small.

Mycetoma

Mycetoma, also called "Madura foot," is a chronic and slowly enlarging infection that starts in the skin but ultimately is destructive to the subcutaneous tissue and muscle with eventual loss of function. Etiologies are certain fungi (eumycetoma) or filamentous bacteria (actinomycetoma). Occasionally the infection may extend to underlying bone. Mycetoma has three characteristic features: tumor formation, draining fistulas, and expelled granules ("grains").

The vast majority of cases of eumycetoma are caused by *Madurella mycetomatis*. Many other fungal species have been reported. Actinomycetoma may be caused by aerobic species of the actinomycetes, including *Nocardia*, *Streptomyces*, and *Actinomyces*.

Epidemiology

Mycetoma is caused by inoculation of the causative organism into the skin through trauma. The disease was initially described in India but is now found in Africa (especially Sudan, Senegal, and Somalia), Mexico, Central and South America, and Southeast Asia. Mycetoma mainly occurs in persons working barefoot in soil or vegetation and is usually contracted from fungal elements entering the skin through a puncture wound caused by a splinter or thorn. The vast majority of cases occur in young men.

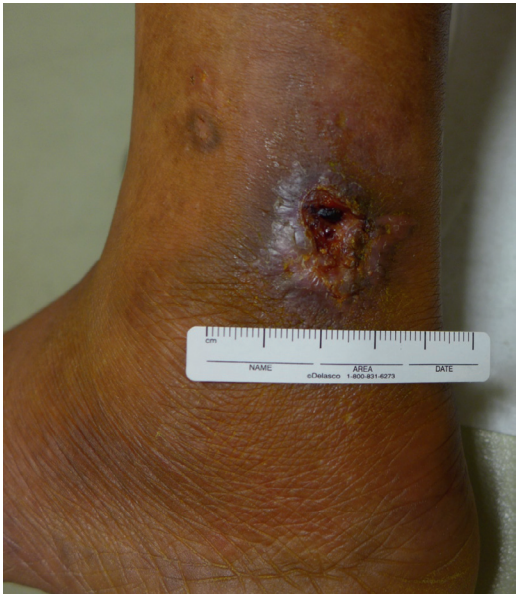

Fig. 38.3 **Early actinomycetoma ulcer with nearby satellite lesion in a traveler.**

Clinical Features

The usual site of inoculation is the foot, but the hands or other areas may be affected. After a latent period of one to several months, a painless subcutaneous nodule develops and slowly enlarges. The lesion progresses to form a large tumor with sinus tracts draining bloody or purulent material (**Fig. 38.3**). The lesion invades slowly by local extension to fascia and muscle and may eventually involve bone. Systemic symptoms are rare and pain is surprisingly infrequent, present in only about one-third of patients.

The sinus drainage typically contains granules, 0.1–5.0 mm in size, which may be white, pink, yellow, brown, or black, depending on the causative organism. Lesions tend to be progressive over many years, and late complications include functional loss, amyloidosis, and sepsis.

Diagnosis

The typical features of *swelling*, *fistula formation*, and *granules* may allow a clinical diagnosis. Specific diagnosis requires examination of the granules with culture. Granules may be obtained from drainage material or biopsy tissue. The most suitable granules for culture of fungi and actinomycetes are taken from the base of a biopsy specimen. Granules may also be crushed and examined in KOH microscopically. The hyphae of eumycetoma are distinguishable from the thin filaments of actinomycetoma.

Biopsy of the lesion will also show the organisms on histologic sections and is useful in ruling out neoplasms that may be in the clinical differential diagnosis. Radiographic imaging can help determine if osteomyelitis is present.

Treatment

Treatment varies based on the causal agent, the affected region, and the degree of invasion. Surgical excision is often recommended for early lesions, and in advanced cases amputation

may be necessary. Surgery should be accompanied by medical treatment because of the risk of recurrence even with wide-margin amputations. Actinomycetoma responds more favorably with fewer recurrences than does eumycetoma. *Nocardia* spp. are treated for several months with trimethoprim-sulfamethoxazole, often combined with dapsone; in severe cases imipenem or amikacin is added. Standard therapy for eumycetoma is itraconazole and terbinafine, sometimes in combination. Avoiding walking barefoot in endemic areas and early wound disinfection is mandatory for prevention.

Sporotrichosis

Sporotrichosis, caused by the fungus *Sporothrix schenckii*, is a fungal infection of the skin, lymphatics, and subcutaneous tissue, which rarely becomes disseminated. *S. schenckii* is found in soil and plant debris in both temperate and tropical climates.

Epidemiology

Sporotrichosis occurs worldwide but is more common in warm, humid climates, with the highest rates of infection occurring in Mexico, Brazil, and South Africa. Infection occurs by inoculation into sites of trauma, and most cases arise in persons whose work predisposes to injury with infected material (e.g., gardeners, florists, and farm workers). An outbreak of 3000 cases was reported in South African mine workers who were exposed by rubbing against infected timber. In the United States, cases occur most often in rose gardeners and nursery workers who handle sphagnum moss.

Clinical Features

The primary lesion occurs at the site of inoculation as a painless dermal nodule that usually breaks down to form a ragged ulcer. The initial lesion may persist for weeks to months or may heal and disappear, only to be followed by further symptoms. In most cases, additional small, dusky red, painless nodules appear over weeks to months along the regional lymphatics. These may also ulcerate and form fistulae. Occasionally, the primary lesion is not followed by regional spread. These solitary lesions may become granulomatous plaques, which often develop smaller peripheral satellite lesions. Lesions may persist for years without therapy. Rarely, dissemination occurs to lungs, bone, CNS, and skin, usually in immunocompromised patients.

Diagnosis

The clinical picture of a painless, indurated ulcer on the hand, which is followed by subsequent lesions along regional lymphatics, should strongly suggest sporotrichosis. The diagnosis is established by isolating the organism, usually from a biopsy specimen. The histology of biopsied lesions shows a mixed granulomatous response but rarely reveals the organism. Fungal culture of biopsy material is the most reliable means of diagnosis, and cultures to rule out the other infections listed previously should always be performed concomitantly.

Lymphatic nodules can also be caused by atypical mycobacteria, particularly *Mycobacterium marinum*, nocardiasis, and tularemia. Solitary lesions must be distinguished from cutaneous tuberculosis, other deep fungi, anthrax, tularemia, and carcinoma.

Treatment

Medical treatment is usually effective. Itraconazole, 100-200 mg daily for 3-6 months, is recommended. Alternatives are terbinafine 500 mg twice per day or saturated solution of potassium iodide (SSKI). Standard therapy starts with 0.5-1 mg/day and is increased to an effective dose of 4-6 mg/day. Although SSKI is inexpensive and effective, patients often do not tolerate it due to associated side effects of hypersalivation and nausea. Finally, hyperthermia has been used to treat the localized form of the disease. Regardless of the therapy chosen, treatment should continue for at least 4 weeks after the resolution of clinical disease.

Lobomycosis

Lobomycosis (keloidal blastomycosis) is an uncommon localized infection of the skin caused by *Lacazia loboi*. In the skin, the fungus takes the form of a spherical intracellular yeast.

Epidemiology

Lobomycosis occurs most commonly in residents and travelers to the Amazon rainforest. It has also been seen in individuals from Central America and Mexico, with sporadic cases seen in France and the United States. The natural reservoir for the organism has not been identified, and the disease is usually seen in young men working in the rural forest. In addition to humans, bottlenose dolphins are infected in the wild.

Clinical Features

Lobomycosis usually begins as small papules or plaques grouped together on areas of exposed skin, most commonly ears, arms, or legs. The early lesions gradually evolve into shiny keloid-like nodules, which usually are either asymptomatic or cause mild itching. Proximal lymph nodes may also be involved. The disease tends to be chronic. Fully formed skin lesions may resemble the nodules of leprosy or sarcoid.

Diagnosis

The diagnosis is suggested by the clinical findings and confirmed by skin biopsy that shows distinctive fungal organisms embedded in histiocytic and giant cell granulomas. The fungi consist of round or lemon-shaped spheres, distributed singly or in short chains. So far culture attempts have been unsuccessful.

Treatment

Treatment generally consists of wide surgical excision of the lesions. Limited success has been reported with clofazimine, itraconazole, and posaconazole.

FURTHER READING

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