

Gram-negative Toe Web Infection Complicated by Myiasis

Jeffrey D. Kravetz, MD, Daniel G. Federman, MD, and Peter Heald, MD

This case, in which the patient's painful symptoms persisted despite ongoing treatment for presumed tinea pedis, highlights the need for heightened awareness of possible bacterial infection in patients at high risk—and illustrates an unusual association with myiasis.

Tinea pedis—commonly known as athlete's foot—is a prevalent dermatologic infection that is estimated to affect almost 20% of elderly individuals.¹ The course of tinea pedis usually is benign and the disease typically is managed effectively by topical antifungal therapy.

In certain individuals, however, tinea pedis can lead to secondary bacterial infections that cause acute exacerbation of the intertriginous reaction. Many of these secondary infections are caused by gram-negative bacteria that gain access to the dermis following damage to the stratum corneum by the initial dermatophyte infection.²

While it is uncommon for people in the United States to develop myiasis (that is, fly maggot infestation), it has been known to occur in preexisting open wounds in the extremities of patients with predisposing risk factors. These risk factors include home-

lessness, alcoholism, and peripheral vascular disease.³

In this article, we report the case of an elderly patient who presented with toe web cellulitis that was ultimately attributed to a gram-negative bacterial infection. A particularly unusual feature of this case was the presence of concomitant subungual myiasis. Following the case presentation, we discuss the two conditions, risk factors for their development, and appropriate treatment.

INITIAL EXAM

An 84-year-old, African American man presented to the primary care clinic at the VA Connecticut Health Care System, West Haven for routine follow-up of his chronic medical issues, which included diabetes mellitus (for which he required insulin therapy), chronic renal insufficiency, and congestive heart failure. At this visit, he reported pain in the toes of both feet but said that the pain had been present for many years. When asked about fever or chills, he responded that he had experienced neither in the recent past. He also said he had not sustained any trauma to his feet, nor had he noticed any drainage or malodorous discharge from his feet.

In addition to diabetes, congestive heart failure, and chronic renal insufficiency, the patient's medical history was significant for hypertension, benign prostatic hyperplasia, and cerebrovascular disease with a prior left frontal cerebrovascular accident. In addition, he had degenerative disc disease in his lumbar spine that made ambulation difficult and he had a long history of onychomycosis. Significant lifestyle factors included the practice of cross-dressing, which involved frequently wearing women's stockings. His medications included insulin, diltiazem, lisinopril, furosemide, metoprolol, aspirin, simvastatin, finasteride, tamsulosin, and tolteradine. He had no known drug allergies.

Approximately three weeks prior to presentation, the patient had visited his podiatrist for a routine diabetic foot examination, during which he was diagnosed clinically with tinea pedis and prescribed carbolfuchsin paint. Since that time, he had been applying this medication topically to his toe webs as directed by the podiatrist.

At physical examination, the patient was observed as an elderly gentleman sitting in a wheelchair in no apparent distress. He was afebrile.

Dr. Kravetz is an assistant professor and **Dr. Federman** is a professor, both in the department of internal medicine, and **Dr. Heald** is a professor in the department of dermatology; all at Yale University School of Medicine, New Haven, CT. In addition, all three authors are staff physicians at the VA Connecticut Health Care System, West Haven.

CASE IN POINT

Continued from previous page

Foot examination revealed chronic 2+ pitting edema in the mid calves of both legs. He was wearing women's stockings, and when these were removed, the patient's feet were noted to be covered with sweat. His toes had evidence of onychomycosis, with onycholysis and subungual debris. The toe web spaces appeared erythematous, with a white-gray discharge, and were malodorous (Figure 1). Underneath the second and third nails on the patient's left foot, three small, white larvae were observed actively crawling. Upon removal, these organisms were identified as maggots under a low power magnification (Figure 2).

TREATMENT COURSE

The patient was diagnosed with toe web infection complicated by myiasis and referred for whirlpool debridement on an outpatient basis. Additionally, he was treated with gentamicin sulfate topical ointment applied twice daily to the toe web spaces. Following each gentamicin application, the toes were separated using cotton gauze.

After two weeks of both therapies, the patient's toe web infection and myiasis resolved. To date, he continues to have onychomycosis but no other acute problems with his feet.

ABOUT THE CONDITION

Gram-negative toe web infections were originally described in 1973, in a case series of 12 patients with either *Pseudomonas aeruginosa* or *Proteus mirabilis* infections of their toe webs.⁴ Despite being known for decades, this clinical entity likely is underrecognized given the high incidence of tinea pedis infections as well as the high prevalence of gram-negative toe web colonization.

In a series of 100 consecutive outpatients being seen for a presumed fungal infection of the foot, only 58%



Figure 1. The patient's toe web spaces, showing erythema and a malodorous, white-gray discharge. Given the patient's recent history of treatment for tinea pedis, a gram-negative toe web infection was suspected, and his subsequent response to gentamicin treatment strongly supported this presumptive diagnosis.

had a dermatophyte isolated on toe web culture, while 24% were found to carry gram-negative bacteria.⁵ Twenty eight percent of these patients reported itching or soreness, 30% reported blisters or maceration, and 32% reported malodor from the toes. The same study found that 41% of industrial workers with damaged toe webs on routine annual physical examination carried gram-negative bacteria in their toe webs, as did 58% of coal miners. Coal miners who were older, had worked the longest in the industry, and reported getting their feet wet were at highest risk for gram-negative bacterial colonization in the toe webs. In addition, miners who reported itching, soreness, cracking, blisters, or maceration had a higher prevalence of gram-negative bacteria isolated from toe web cultures.⁵

Few case series have elucidated the risk factors and epidemiology of gram-negative toe web infection. The largest of these studied 123 individu-



Figure 2. Gross appearance of a maggot removed from the patient's toe.

als diagnosed with such infections at one institution.² Most (78%) of these patients were male, with an age range of 19 to 74 years. Just over half of them (56%) had received previous inadequate treatment for presumed tinea pedis or had recently received topical antifungals, antibiotics, or corticosteroids; 20% had allergic contact dermatitis; 14% had primary or secondary hyperhidrosis; and 10% used swimming pools, public baths, or hot

Continued on page 19

Continued from page 16

tubs. The most common bacterium isolated was *P. aeruginosa* (46%), followed by *Escherichia coli* (14%) and *P. mirabilis* (8%). Concomitant gram-positive and gram-negative infection was noted in 17% of cases, with the most commonly isolated gram-positive bacterium being *Staphylococcus aureus*. Concomitant fungal infection with *Candida albicans* was found in only 5% of cases, and other dermatophytes accounted for only 1% of combined fungal and bacterial infections.

Recent treatment of presumed tinea pedis is a strong risk factor for gram-negative toe web infection. Dermatophytes that typically cause tinea pedis produce a penicillin-like substance that selects for the growth of gram-negative bacteria and penicillin-resistant, gram-positive bacteria.^{1,2,5} In addition, as the fungus grows, it invades the epidermis and produces byproducts that neutralize the pH and further promote the growth of gram-negative bacteria.¹ Once the fungal infection has been treated effectively with topical antifungals, the macerated skin no longer provides an effective barrier to the gram-negative bacteria and there is a high risk of a gram-negative toe web infection.

Our patient had been applying carbolfuchsin topical solution (also known as Castellani's paint) for presumed tinea pedis for several weeks prior to presentation. In addition, his risk of infection probably was increased by his diabetes and his habit of wearing women's stockings, which likely caused frequent hyperhidrosis of his legs. Although cultures of this patient's toe web infection were not performed to confirm the presence of gram-negative bacilli, the diagnosis is strongly supported by the fact that his symptoms, which had persisted despite continuing carbolfuchsin treatment, responded rapidly to gentamicin ointment. In hindsight, it

is difficult to say whether the patient developed bacterial superinfection of primary tinea pedis or whether his symptoms were caused by a misdiagnosed gram-negative infection from the outset.

Treatment of gram-negative toe web infection involves a combination of antibiotic and topical therapy. Debridement of any necrotic tissue is imperative and can be performed through whirlpool therapy, if available, or manually by a podiatrist or dermatologist. Topical antibiotics with activity against *P. aeruginosa* can be used as first-line therapy, with oral or intravenous antibiotics reserved for more severe infections with systemic manifestations. Toe web cultures can be used to guide therapy in cases that are resistant to first-line therapy.

Myiasis: An uncommon complication

The patient described in the case report also had myiasis complicating his toe web infection. In our literature search, we found no reported cases of myiasis complicating either tinea pedis or gram-negative toe web infection. Most cases of myiasis reported to occur in the United States arise from deposition of eggs from noninvasive blowflies in preexisting wounds.³ Most patients with myiasis are male, with an average age of 60 years. Other risk factors include homelessness, alcoholism, and peripheral vascular disease. While our patient did not have any of these risk factors, his personal hygiene was poor and his home was not well kept.

Treatment of myiasis involves removal of the maggots from the wound, either directly or through irrigation of the wound with sterile saline or an antimicrobial solution. In this case, three maggots were removed easily with tweezers. In deeper wounds, the maggots may

be difficult to visualize, and various methods have been used to induce the maggots to come to the surface of the skin. Soaking the wound in a mixture of 3% hydrogen peroxide or povidone-iodine and sterile saline or water for 20 minutes, for instance, will cause the maggots to leave the wound to avoid drowning. Following this, the wound can be irrigated with sterile saline or water.⁶ Other methods that have been used less commonly but with success include immobilizing and freezing the maggots (in lower extremity wounds) with ethylene chloride⁷ and covering the wound with bacon fat to induce the maggots to the surface.⁸

SUMMING UP

Gram-negative toe web infections are a well described, though likely under recognized, cause of severe intertrigo in certain high risk individuals. Recognition of this infection is important, as topical antifungals will provide no benefit and topical or systemic antibiotics are required for successful treatment. While uncommon, myiasis has been known to complicate other wounds and, as illustrated by this case, can complicate gram-negative toe web infections. Careful visual inspection for crawling larvae should be performed in suspected cases. ●

Author disclosures

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