

ORIGINAL ARTICLES

Interdigital Erythrasma: Clinical, Epidemiologic, and Microbiologic Findings

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Abstract. *Background.* Erythrasma is a superficial infection caused by *Corynebacterium minutissimum* and affects the major skin folds and the interdigital regions of the feet. It is characterized by erythematous, brown, scaly patches and maceration, and exhibits coral-red fluorescence under Wood light.

Objective. The aim of this study was to determine the frequency of erythrasma in patients with interdigital lesions.

Methods. An open, prospective, longitudinal, observational study was performed in a hospital in Mexico City between March and December, 2006. All patients with interdigital lesions were examined with a Wood lamp and direct examination was performed with 20% potassium hydroxide. Cultures were done in Sabouraud dextrose agar and brain heart infusion agar, and smears were analyzed. General characteristics and concomitant diseases were recorded.

Results. We examined 73 patients, of whom 24 (32.8%) were diagnosed with erythrasma based on coral-red fluorescence under Wood light and identification of corynebacteria by Gram staining. The disease was more common in women (83.33%) and the mean age of the patients was 43.5 years. The main clinical findings were scaling and maceration, and the fourth interdigital web was the most commonly affected. *Corynebacterium* could not be isolated in any of the cases. Mycology was positive in 15 cases (62.5%) and the following microorganisms were isolated: *Candida* (16.6%), dermatophytes (12.5%), and *Trichosporon* (4.1%).

Conclusions. Interdigital erythrasma is a common condition and can be easily confused with interdigital tinea. It persists if not treated appropriately. Rapid diagnosis is easily obtained by examination with a Wood lamp, while culture is difficult and unnecessary for diagnosis. The coexistence of erythrasma with dermatophytes and *Candida* should be considered when the interdigital webs are affected.

Key words: Erythrasma. *Corynebacterium minutissimum*. Wood light.

ERITRASMA INTERDIGITAL: DATOS CLÍNICOS, EPIDEMIOLÓGICOS Y MICROBIOLÓGICOS

Resumen. *Antecedentes.* El eritrasma es una infección superficial causada por *Corynebacterium minutissimum*, que afecta grandes pliegues y regiones interdigitales de los pies. Existe eritema, descamación, manchas color marrón y maceración; se presenta con fluorescencia rojo coral con luz de Wood.

Objetivo. Determinar la frecuencia de eritrasma en pacientes con lesiones interdigitales.

Métodos. Se realizó un estudio prospectivo, abierto, observacional y longitudinal en un hospital de la ciudad de México de marzo a diciembre de 2006. A todos los pacientes con lesiones interdigitales se les realizó luz de Wood, examen directo con hidróxido de potasio al 20 %, cultivo en agar dextrosa Sabouraud, frotis y cultivo en infusión cerebro-corazón. Se documentaron los datos generales y enfermedades concomitantes.

Resultados. Examinamos 73 pacientes, 24 (32,8 %) presentaron eritrasma diagnosticado por la fluorescencia rojo coral y la identificación de la corinebacteria por tinción de Gram. Fue más frecuente en mujeres (83,33 %) y la edad promedio fue 43,5 años. Los principales datos clínicos fueron descamación y maceración

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y el cuarto pliegue fue el más afectado. En ningún caso se pudo aislar el microorganismo en el cultivo. El examen micológico fue positivo en 15 casos (62,5 %) y se aislaron: *Candida* (16,6 %), dermatofitos (12,5 %) y *Trichosporon* (4,1 %).

Conclusiones. El eritrasma interdigital es frecuente y puede confundirse fácilmente con tiña interdigital. Es persistente sin tratamiento adecuado. El diagnóstico es rápido y accesible con luz de Wood y el cultivo es difícil y no es indispensable para el diagnóstico. Debe considerarse la coexistencia de eritrasma con dermatofitos y *Candida* cuando afecta los pliegues inderdigtales.

Palabras clave: eritrasma, *Corynebacterium minutissimum*, luz de Wood.

Introduction

Erythrasma, also referred to in Spanish as cutaneous corynebacteriosis (*corinebacteriosis cutanea*), is a superficial pseudomycosis caused by the lipophilic, diphtheroid, filamentous, gram-positive bacillus *Corynebacterium minutissimum*. This bacterium is thought to be a normal resident of the skin, and in some populations, it has also been found both in genital areas (prevalence of 4%-20%) and in the interdigital spaces of the feet (prevalence of up to 69%), in coexistence with other microorganisms. The bacillus releases a porphyrin that causes the lesions to fluoresce, although the role of this compound in the pathophysiology of erythrasma remains unclear.^{1,2}

Erythrasma primarily affects the inguinal, axillary, and submammary folds and is characterized by plaques which are a light-coffee color although they can also be a light red at first before turning brown. Lesions can be punctate or cover areas of up to 10 cm or greater. They may also be polycyclic, have sharp borders, and be covered in fine scales. The lesions are normally asymptomatic, although some patients may report mild pruritus. The course of disease is chronic and remission does not tend to occur. Lesions in the interdigital spaces of the feet are characterized by erythematous plaques, maceration, scaling, blisters, vesicles, and a foul odor. When nails are involved, these turn yellow and exhibit thickening and ridging.¹⁻⁴ *C. minutissimum* often coexists with other bacteria, dermatophytes, and *Candida* species.⁵

Examination with a Wood lamp reveals coral-red or orange fluorescence; for optimal results, affected areas should not be cleaned prior to examination.^{1,6} Direct examination with potassium hydroxide reveals rods (isolated or in chains) and intertwining filaments measuring on average 4 µm to 7 µm, with coccoid forms measuring between 1 µm and 3 µm. Ideally, scale samples should be mounted on a slide or collected using transparent adhesive tape and immediately stained with methylene blue for 2 to 3 minutes. Gram staining of smears reveals thin straight or slightly curved gram-positive bacilli with club-shaped ends, forming a distinctive V-shaped or Chinese letter (cuneiform) pattern.^{7,8}

Culture is difficult and unnecessary for diagnosis. Special culture media such as brain heart infusion (BHI) agar, blood agar, and media enriched with 20% fetal bovine serum are used. Classification of *Corynebacteria* species is also complicated and requires special media such as Loeffler medium, Tinsdale medium, and tellurite agar. Cultures are incubated at 37°C in a mixture of pure nitrogen (5% to 10%) and carbon dioxide. Colonies form within 48 to 72 hours and measure 2 to 3 mm; they are translucent, convex, and nonhemolytic. Wood lamp examination reveals red fluorescence and microscopic examination diphtheroid microorganisms. A biopsy is unnecessary for diagnosis.^{1,7}

Complications associated with erythrasma are contact dermatitis, lichenification, pigmentation, and coinfections due to other bacteria, yeast, or dermatophytes. The treatment of choice, with excellent results, is erythromycin or tetracycline administered orally at a dose of 1 g per day for at least a week. Clarithromycin administered as a single dose or azithromycin administered over several days is equally effective.^{9,10} Resolution of lesions takes twice as long with 20% sodium hyposulfite, keratolytic creams, or 2% sulfur with Whitfield ointment. Other topical agents include creams containingazole derivatives, ciclopiroxolamine, antibiotics such as mupirocin, clindamycin, and fusidic acid, 20% aluminium chloride, and antibacterial soaps.¹⁰⁻¹² Prognosis is good and remissions do not tend to occur.

Material and Methods

An open, descriptive, observational, cross-sectional study was performed in the Mycology Department of Hospital General Dr. Manuel Gea González in Mexico City from March to December, 2006. We included patients of both sexes and all ages who presented with interdigital lesions except those who had received topical or systemic antibiotics in the preceding month. All the patients, or their legal guardians, signed an informed consent form before participating in the study. We examined the interdigital spaces between each toe using a Wood lamp and in patients in whom coral-red fluorescence was observed we took a sample of scale or macerated skin for Gram staining and culture in

BHI agar. We also took a sample from all patients for direct mycologic examination with 20% potassium hydroxide and culture in Sabouraud dextrose agar (Figure 1).

For each patient, we collected information on general characteristics, concomitant diseases such as diabetes mellitus and obesity (defined by a body mass index of >25), time since onset of skin lesions, and previous treatments. Clinical signs analyzed were erythema, hyperpigmentation, scaling, maceration, sweating, and foul odors. The only symptom considered was pruritus. Signs and symptoms were classified according to severity (absent, mild, moderate, and severe). We examined the interdigital spaces of affected toes and searched the rest of the body for similar lesions in all patients with a positive result in Wood lamp examination. Diagnosis was confirmed following the visualization of coral-red fluorescence under Wood light and the identification of intertwining filaments measuring 4 to 7 μm , rods, and Chinese letter patterns in the Gram-stained smears. Treatment was prescribed by the attending physician at the Dermatology Department of the hospital where the study was carried out in all cases and patients were asked to return to the Mycology Department a month after initiation of treatment for re-examination under Wood light.

Results

Of the 73 patients with interdigital lesions who were included in the study, just 29 exhibited coral-red fluorescence under Wood light (Figure 2). Gram staining in those patients revealed the presence of *Corynebacterium* species in 24 cases, but cultures on BHI agar were negative in all cases. It was therefore considered that 24 patients (32.8%) with interdigital lesions had interdigital erythrasma (Figure 3). Twenty (83.3%) of these were women and 4 were men (16.7%). They had a mean age of 43.5 years (range, 13-78 years) and were all residents of Mexico City. The majority of patients (n=8, 33.3%) worked in the home, other occupations included student (n=3, 12.5%), sales staff (n=2), cleaning staff (n=2), and miscellaneous.

The reported period since onset of the disease ranged from 1 month to 5 years, with a mean length of 9.4 months. Seven (29.2%) of the patients had received previous treatment: 6 with topical antifungal medication and 1 with systemic antifungal medication. Concomitant disease was not common: just 3 patients had diabetes mellitus and 12 were obese (including 2 of the patients with diabetes mellitus).

The most common clinical sign was scaling, affecting 95% of patients, followed by maceration, affecting 91% (Figure 4 and Table 1). The fourth interdigital space was the most frequently affected area (in 91% of patients) and the number of affected webs ranged from 1 to 8, with an average of 4. Two patients also had lesions on the soles of

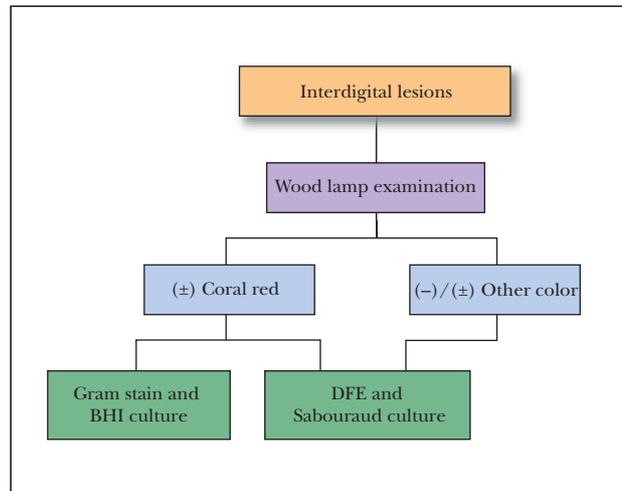


Figure 1. Flow diagram of study of interdigital lesions to determine the presence of interdigital erythrasma. (±) indicates positive fluorescence result; (-), negative fluorescence result; BHI, brain heart infusion; DFE, direct fungal examination with 20% potassium hydroxide.



Figure 2. Coral-red fluorescence from interdigital lesions seen under Wood light in a dark room.

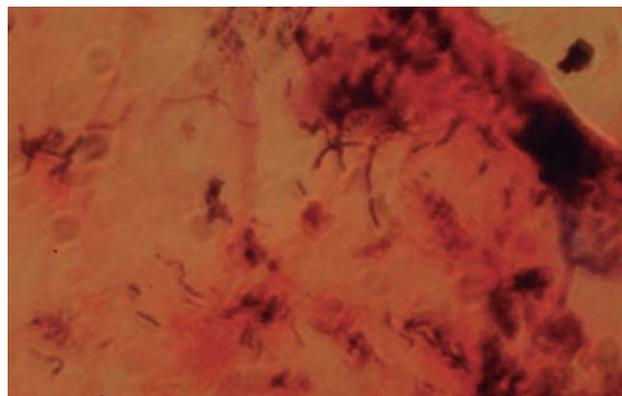


Figure 3. Smear showing thin filaments with Chinese letter patterns and coccoid forms corresponding to *Corynebacterium minutissimum* (Gram stain, original magnification $\times 100$).

Table 1. Severity and Frequency of Clinical Features of Interdigital Lesions in Patients with Erythrasma^a

	Absent	Mild	Moderate	Severe	Patients Affected
Hyperpigmentation	18	4	2	0	6
Erythema	5	15	4	0	19
Scaling	1	12	11	0	23
Maceration	2	11	10	1	22
Vesicles-blisters	23	1	0	0	1
Foul odor	8	13	1	2	16
Sweat	6	13	4	1	18
Pruritus	13	7	4	0	11

^aData are shown as number of patients.



Figure 4. Tinea pedis and erythrasma in all interdigital spaces.

the feet that fluoresced on examination with a Wood lamp. One patient had lesions in the inguinal area.

Direct fungal examination was negative in 9 patients (37.5%) and positive in 15 (62.5%); filaments were found in 13 patients and filaments and spores in 2. Sabouraud dextrose agar culture was negative in 16 patients (66.7%) and positive in 8 (33.3%). Isolated organisms included *Candida* species, dermatophytes, and *Trichosporon* species (Table 2).

A range of treatments were indicated, including topical erythromycin in 9 patients, fusidic acid in 5, oral erythromycin in 3, oral terebinthine in 1, and a combination of treatments in 5. Only 21 patients returned for the follow-up Wood lamp examination a month later. The corresponding results were negative in 20 patients and positive in 1 patient, who had received oral terebinthine to treat concomitant dermatophytosis.

Table 2. Agents Isolated in Sabouraud Dextrose Agar in Patients With Erythrasma and Coinfection

Agent Isolated	Frequency, No. (% of total, n = 24)
<i>Candida</i> species	3 (12.5%)
<i>Candida albicans</i>	1 (4.1%)
<i>Trichophyton rubrum</i>	2 (8.3%)
<i>Epidermophyton floccosum</i>	1 (4.1%)
<i>Trichosporon</i> species	1 (4.1%)

Discussion

There is a lack of epidemiologic data on interdigital erythrasma and reported prevalence varies greatly from one study to another. Arce et al,¹³ for example, reported a prevalence of 0.47% in an intentional study of erythrasma in patients referred to the mycology department at a hospital in Mexico City, while Svejgaard⁵ reported a prevalence of 77.1% in a group of military recruits. The discrepancy is very probably related to the type of population studied, as military personnel have an increased risk of developing erythrasma due to exposure to heat and damp conditions. We found a prevalence of 32.8% in our study of the frequency of erythrasma in patients with interdigital lesions who visited our department.

In a study of patients with diabetes, Somerville and Lancaster-Smith found that 44% had interdigital erythrasma. Henslee et al¹⁰ reported a prevalence of 58% and 43%, respectively, in patients with and without diabetes mellitus. In our study, the association between erythrasma and diabetes mellitus was not statistically significant, although the aim of the study was not specifically to address such an association. We did, however, find that patients with diabetes had a relative risk of 1.6 (95% confidence

interval, 0.367 to 6.981) for developing erythrasma. There was also no statistically significant association between obesity and erythrasma in our series, and to the best of our knowledge, there are no reports of such an association in the literature.

In a study of 300 consecutive patients who visited a dermatology hospital, 109 (36.3%) had signs of interdigital or plantar infection, 42 (14%) had erythrasma alone, 42 (14%) infection by dermatophytes alone, 12 (4%) coinfection by dermatophytes and *C. minutissimum*, 5 (1.7%) *Candida albicans* alone, and 2 (0.7%) coinfection by *C. minutissimum* and *C. albicans*; there was no evidence of microorganism growth in 6 patients (2%).¹⁰ These data show that erythrasma occurs alongside infection with other agents in only 4.7% of cases of interdigital infection. Other agents were isolated in 8 of the 24 patients with erythrasma in our series. These were *Candida* species (n=3, 12.5%), *C. albicans* (n=1, 4.1%), *Trichophyton rubrum* (n=2, 8.3%), *Epidermophyton floccosum* (n=1, 4.1%), and *Trichosporon* species (n=1, 4.1%). This prevalence of 33.3% is higher than coinfection rates reported in previous studies.

Conclusions

Erythrasma is a bacterial infection that commonly affects the interdigital spaces of the feet and is easily confused with tinea pedis. It is a chronic, persistent disease if not treated appropriately. Lesions fluoresce a coral-red color under Wood light, and examination with a Wood lamp represents an inexpensive, noninvasive diagnostic method that can be used in all patients. It is also very quick and specific. Culture is difficult and unnecessary for diagnosis.

The coexistence of other pathogenic agents in erythrasma must be considered in the case of interdigital infection as combined treatment with antifungal agents and antibiotics is required. The course of disease and prognosis of interdigital erythrasma is very favorable if appropriate treatment is

provided. If not, the disease does not spontaneously resolve. It is particularly important to instruct patients on appropriate hygiene measures to reduce constant exposure to heat and damp in the feet and thus avoid bacterial and fungal infections.

Conflicts of Interest

The authors declare no conflicts of interest.

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