

Original article

A clinico-etiological study of toe web fungal infection

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Abstract *Background* Toe web fungal infection is a communicable disease and there have been many outbreaks in schools, orphanages, dormitories and other places. It is a common inflammatory skin condition which causes great discomfort and morbidity. We determined the various clinical forms of the disease and isolated the causative fungal pathogens.

Patients and methods During a period of nine months, 118 clinically suspected cases of toe web fungal infection were enrolled. The specimens from the involved toe webs were taken for direct microscopy and cultured on Sabouraud's dextrose agar with chloramphenicol and with or without cycloheximide. Culture swabs for bacteriology were also taken to rule out any other causative agent besides fungi in each patient.

Results The study revealed that toe web fungal infection was common in males and females between the ages of 21-50 years. Fourth toe web was the most commonly affected bilaterally. The intertriginous variety was the most frequent clinical presentation seen in 53 (83.3%) patients. Out of total 118 patients, 60 patients (50.8%) showed positive culture for fungus and 30 cases (25.4%) revealed positive culture for bacteria, including 6 patients in which dermatophytes as well as bacteria were isolated. The most common pathogen isolated was *Candida albicans* in 36 (60%) followed by *Trichophyton rubrum* in 19 (31.7%), *T. violaceum* in 4 (6.6%), and *Epidermophyton floccosum* 1 (1.7%) case. The bacteria isolated were *Staphylococcus aureus* in 25 (83.4%), *Pseudomonas aeruginosa* in 3 (10%) and *Proteus* spp. and β -hemolytic *Streptococci* in 1 (3.3%) case each, respectively.

Conclusion Toe web intertrigo is the most common type seen in our study caused by *Candida albicans* followed by *T. rubrum*, *T. violaceum* and *E. floccosum*. The patients between ages 21 to 50 years are more vulnerable to toe web fungal infection.

Key Words Tinea pedis, Sabouraud's dextrose agar, *Candida*, *Trichophyton rubrum*, *Trichophyton violaceum*, *Epidermophyton floccosum*.

Introduction

Fungal infections are prevalent throughout the world.¹ Toe web fungal infection clinically manifests as scaling, maceration,

vesicopustules, bullae and ulceration in the interdigital and subdigital areas.^{2,3,4} Mostly, dermatophytes are the primary pathogens² but *Candida* spp., *Scytalidium hyalinum* and *S. dimidiatum* are also implicated.^{3,5,6,7} The anthropophilic dermatophytes *Trichophyton rubrum*, *Epidermophyton floccosum* and *T.*

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mentagrophytes var. *interdigitale* are the common pathogens involved in toe web infection.^{2,3,7}

Lateral toe webs are the most common sites of infection.^{2,3,7} Hyperhidrosis may be an underlying problem for a number of patients.^{2,7} The style of wearing closed shoes and sneakers probably contributes to the increasing frequency of the disease.^{5,7} Hot and humid climate, rising standards of life and urbanization suggest a high incidence of the disease in developed communities.^{5,7} Different clinical types of the infection include intertriginous, vesiculo-bullous or pustular and acute ulcerative lesions.^{2,4,7}

The present study was planned at the Department of Dermatology, Mayo Hospital, Lahore, to study the clinico-etiological aspects in patients of toe web fungal infection in our community.

Patients and methods

The study was carried out from March to November, 2000. The patients of any age and either sex, clinically suspected of toe web fungal infection, attending the mycology clinic of Department of Dermatology, King Edward Medical College/Mayo Hospital, Lahore were enrolled. A detailed history, clinical examination and relevant laboratory investigations including Wood's lamp examination, were recorded on a pre-devised proforma. Patients showing fissuring, scaling, and maceration of toe webs were labeled as intertriginous type, while those with small vesicles, vesicopustules or bullae were grouped as vesiculo-bullous type and those with denudation, ulceration and weeping were classified as ulcerative type of toe web infection.

Patients, whose disease was confirmed by direct microscopy and fungus culture, were included in the study for evaluation. Patients on systemic anti-fungal therapy for the last 4 weeks or topical anti-fungal therapy for the last 1 week, were excluded. The most severely affected toe web was selected for direct microscopy and culture. Samples were taken on a black paper with a blunt scalpel, after cleaning the toe web with 70% alcohol, for direct microscopy with 20% potassium hydroxide (KOH) and 40% dimethyl sulphoxide (DMSO) solution. Samples were also examined with the help of 20% KOH along with calcofluor white stain (1 part of KOH and 1 part of calcofluor white stain) under the fluorescent microscope. The specimens were inoculated for fungus culture on Sabouraud's dextrose agar along with 0.005% chloramphenicol and with or without 0.05% cycloheximide. The cultures were inoculated at 25-30°C for 4-6 weeks. The pathogens were identified by gross colony morphology and microscopic examination of mounts formed with lactophenol cotton blue preparation. Those samples, which were positive on direct microscopy but failed to grow, were cultured at least 3 times. In cases of concomitant fungal infections of feet, hands or other body sites, the samples were also taken from these affected sites. The diagnostic criteria of English were followed.⁸

Bacterial cultures were taken from affected toe webs in sterile culture tubes and inoculated on MacConkey's agar and blood agar plates.

Results

Of 60 evaluable patients, 34 (56.7%) were males and 26 (43.3%) females (mean age 32.6 years, range 11-75 years). The male to female ratio was 1.3:1. Fifty three

patients belonged to urban area and 7 came from rural background. Duration of disease ranged from 2 weeks to more than a year. Twenty four patients (40%) belonged to poor socioeconomic class, 30 (50%) to higher socioeconomic background and 6 patients (10%) were from middle class. There were 20 (33.3%) housewives; 4 (6.7%) each of students, bankers, clerks, factory workers and labourers; 2 (3.3%) each of carpenters, painters, watchmen, shop keepers, businessmen, drivers, jewelers; and 1 (1.7%) each of tailor, farmer, teacher, and laboratory worker. Fifty eight (96%) patients experienced definite seasonal variation with aggravation of the disease in hot and humid weather. Trauma was the provoking factor in 10 (16%) patients. Forty one (68%) patients admitted to bathing more than once a day. Concomitant fungal infection of other body areas was seen in 15 patients (25%). These included tinea unguium in 6 (10%), tinea cruris in 4 (6.6%), tinea manuum in 3 (5%) and tinea corporis in 2 (3.3%). Cultures were positive from the diseased sites and the species involved were the same as that causing toe web infection. Four (6.6%) of the patients had diabetes mellitus and hypertension, 2 (3.3%) had atopic dermatitis, and 1 (1.7%) patient had ischemic heart disease and chronic

Table 1

KOH	Mycological results (n=118)		Total
	Positive	Negative	
Positive	52	28	80
Negative	8	30	38
Total	60	58	118

Toe web intertrigo was the most frequent clinical type seen in 53 (88.3%) patients. The next most frequent variety was vesiculo-bullous and pustular type which was found in 4 (6.7%) cases. Acute ulcerative type was encountered in 3 (5%) patients. Associated (pompholyx-like) ide reaction was seen in 4 (6.7%) patients.

On clinical examination of the patients, combination of different morphological types of toe web infection was seen. The most frequent was the involvement of 4th toe webs of both feet and this was seen in 25 (41.76%) patients. Multiple toe webs were involved in 54 (90%) patients. Single toe web disease was seen in 6 (10%) cases. Single foot involvement was noticed in 22 (36.7%) whereas both feet were involved in 38 (63.3%) patients. Mean number of involved toe webs was 2.97 ± 1.09 . Mycological results are given in **Table 1**. Out of these culture positive cases, 8 were negative on KOH mount preparation. **Table 2** shows the clinicoetiologic

Table 2

Clinical Type	Clinico-aetiological correlation (n=60)			
	<i>Candida</i>	<i>T. rubrum</i>	<i>T. violaceum</i>	<i>E. floccosum</i>
Toe web intertrigo	34	15	4	0
Vesico-bullous	0	3	0	1
Acute ulcerative	2	1	0	0
Total	36	19	4	1

urticaria.

correlation between the isolated pathogens and clinical presentation.

Of the total 118 patients registered in the study, 30 patients had positive bacterial cultures with *Staphylococcus aureus* being the most common organism isolated in 25 (83.4%) patients. The other bacterial species isolated were *Pseudomonas aeruginosa* in 3 (10%) and *Proteus* spp., and β -haemolytic streptococci each in 1 (3.3%) patient. Six of these cases were also positive for fungal culture, four cases of *C. albicans* and 2 of *T. rubrum*.

Discussion

Toe web fungal infection is mainly caused by dermatophytes but non-dermatophytes are also incriminated in its aetiology.^{2,3,7} Majority of our patients were adults and 70% (n=42) were between 21-50 years of age. This is in agreement with other similar reports.⁷ The reasons for low prevalence of toe web fungal infection in children may be that they are less exposed to predisposing factors e.g. humidity, trauma etc.⁷ In our study 56.7% (n=34) were males, reason being wearing closed shoes most of the time and hot and humid climate as seen in other studies.⁷ Twenty six (43.3%) with toe web fungal infection were females and the majority were housewives. Household work (kitchen work and washing of clothes and floors), done by our housewives may be the predisposing factor in these cases. Eighty eight per cent of the patients presented from urban community and only 12% from the rural area. There can be various reasons for this difference e.g. an easy access to hospital, or the disease may be more frequent in this segment of population due to overcrowding and occlusive footwear. Other occupations affected by the disease included students, bankers, shop keepers, painters and tailors etc.

Sixty eight per cent of the patients had frequent bathing habits with consequent increased wetting of toe webs predisposing to fungal infection. In a study

conducted by Raboobee *et al.*⁹ there was an increased prevalence of tinea pedis in Muslim worshippers using a common place for ablution. Ninety six per cent of the patients experienced seasonal aggravation in hot and humid weather. This fact is also in accordance with other reports.⁷ Concomitant fungal infection of other body sites was seen in 25% of the patients, tinea unguium being the most common. This is also in accordance with the study by Aman *et al.*¹⁰

Toe web intertrigo was the most common clinical presentation seen in 53 (88.3%) patients. The vesicobullous and pustular type of toe web fungal infection was seen in 4 (6.7%) while acute ulcerative type was the presentation in 3 (5%) cases. The various clinical patterns in our setting are in accordance with other studies. Jang *et al.*¹¹ reported intertriginous type of tinea pedis as the most common form (53.3%) and Soghair *et al.*¹² noted the same in 91.9% of patients. The study by Merlin *et al.*¹³ showed erythema and scaling in the toe webs in 84.6% and 90.2% patients, respectively and 14.4% had vesicular type of infection. Mixed presentation was seen in 3(5%) cases. Our study revealed a high rate of positivity, with direct microscopy using KOH+DMSO and with calcofluor white stain under fluorescent microscope. It shows that DMSO and calcofluor white have additive effect when used for direct microscopy. In our study, 118 patients were suspected of toe web fungal infection and 60 (50.8%) had positive culture and among these, 90% had positive direct microscopy. The rate of culture positivity is in accordance with a similar study i.e. 57% by Jang *et al.*¹¹ Culture failure could be due to overgrowth of bacterial species, which leads to maceration of the toe webs and prevention of the growth of dermatophytes. Other organisms involved in the etiology of toe web fungal infections vary in different studies due to

multiple reasons. The variations in population type, the habits of foot wear, geographical and climatic conditions as well as variability in laboratory techniques and culture media are responsible for this difference.

In the present study, 36 (60%) of the cases showed *C. albicans* as the causative pathogen and among these patients 34 (94.4%) presented as toe web intertrigo while 2 (5.6%) as acute ulcerative type. Similar results have been reported in other studies by Soghair *et al.*¹² which showed 88.9% of the cases due to *C. albicans* and other yeasts but study by Lupa *et al.*¹⁴ demonstrated *T. rubrum* as the commonest pathogen involved in 41.7% of the cases. Among the dermatophytes, *T. rubrum* was the most common dermatophyte isolated in 19 (31.7%) of our cases. The study conducted by Jang *et al.*¹¹ showed *T. rubrum* as the incriminated pathogen in 69.2% of the cases. The other dermatophytes isolated were *T. violaceum* 6.6% (n=4) and *E. floccosum* 1.7% (n=1).

As regards the bacterial cultures, we isolated *Staph. aureus* as the most common bacteria from toe webs in 25 (83.4%) patients, *Pseudomonas aeruginosa* in 3 (10%) patients, *Proteus* spp. and β -hemolytic *Streptococci* in 1 each (3.3%), respectively. There were six patients in whom both bacterial and fungal cultures were positive (*Candida* in 4 and *T. rubrum* in 2 patients). This demonstrates an ecological interplay between dermatophytes, candida and bacterial species.

Conclusion

It is concluded that adults between the ages of 21-50 years are more vulnerable to toe web fungal infection with no significant difference between males and females. Toe web intertrigo is the most common clinical form of presentation. *C. albicans* is the most common non-dermatophyte isolated while *T. rubrum* is

the most common dermatophyte incriminated in etiology of toe web fungal infection. *T. violaceum* and *E. floccosum* are rare pathogens in toe web fungal infection.

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