

PREVALENCE OF PATHOGENIC FUNGI IN THE TOE-WEBS AND TOE-NAILS OF DIABETIC PATIENTS

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Abstract

100 diabetic and 100 diabetes-free patients were mycologically examined for the presence of pathogenic fungi in their toe-webs and toe-nails. While there were clinical signs of presumed mycotic infection in 73 of the diabetic and in 66 of the non-diabetic subjects, the examination of the KOH-treated specimens revealed fungal elements in only 70 of the former and in 53 of the latter group. Isolation of the causative agent was possible in 57 of the diabetic patients (*T. rubrum* in 46 %, *C. albicans* in 31 %, *T. mentagrophytes* in 21 % and *E. floccosum* in 3 %) and in 40 of the control group (*T. rubrum* 57,5 %, *T. mentagrophytes* 35 %, *C. albicans* 5 %, *E. floccosum* 2,5 %). An interesting correlation was observed between the level of blood sugar and the percentage of positive fungal findings, the patients with more than 3000 mg/ml being 100 % affected. *C. albicans* was found in a lower percentage in non-diabetic patients. The *in vitro* test of the sensitivity of the isolated organisms to the antidiabetic drugs, received by the patients, showed no significant anti-fungal activity.

Introduction

There exists some controversy as to whether superficial fungous infection of the skin is more common in diabetics or not. While some authors, such as Rhodes (6), have stated that there is a much higher incidence of fungal involvement of the feet in diabetics than in the general population, others, such as Fusaro & Goetz (2) and Somerville & Lancaster (8), reported that the incidence of dermatophytosis or yeast infection is not significantly higher in diabetics than in normal subjects. As Eisert (1) has pointed out however, the prevention of a skin disorder by fungi in diabetics is important in diminishing the possibility of occurrence of a cellulitis or even gangrene. Since the interdigital spaces of the feet and the toe-nails

constitute one of the main sites of invasion by dermatophytes and yeasts in tropical and subtropical climates, we thought it of interest to carry out a study on the presence of pathogenic fungi in this location in diabetic patients.

Materials and methods

The patients material comprised a total of 100 patients, 44 males and 56 females with an age range from 21 to 80 years, suffering from diabetes mellitus. The patients were carefully examined for the presence of furfuraceous scaling and fissures or white, macerated epidermis in the toe-webs, particularly between the fourth and fifth toes, as well as suggestive signs of toe-nail involvement such as discoloration and lack of luster of the nail plate, pitting, accumulation of epidermal detritus beneath the nail, etc.

No matter whether pathological changes were evident or not, scrapings were taken from both sites in each patient. These were subjected to mycological investigation, direct microscopic examination in KOH and culturing on slants and tubes with Sabouraud's glucose agar supplemented or not with Actidione and Chloramphenicol.

A glucose tolerance test was performed in each of the patients. Furthermore, an *in vitro* test of the antifungal activity of the antidiabetic drugs being received by the patients was carried out upon the isolated agents using the agar plate diffusion method, the results being graded from + tot + + + + in accordance with the diameter of inhibition (one cm = +).

For purposes of control, a random group of 100 diabetes-free patients were subjected to identical clinical and mycological investigations.

Results and comments

While there were clinical signs of presumed fungal invasion in the toe-webs and toe-nails of 73 of the patients, exami-

nation of the KOH-treated specimens revealed fungal elements in only 70. Repeated culture led to the isolation of the causative agent in 57 of the 70 patients with positive microscopic findings.

The following fungi were recovered from the diabetic patients: *T. rubrum* in 46 % of the positive cases, *C. albicans* in 31 %, *T. mentagrophytes* in 21 % and *E. floccosum* in 2 %. In respect to the site of invasion, *T. rubrum* was more frequently isolated from the toe-webs than from the toe-nails while *C. albicans* was preferential to the toe-nails and secondly to the toe-webs.

It is of interest that usually toe-nails are not a preferential site for *C. albicans* invasion. It is possible, however, that in diabetic patients the fungus finds it easier to penetrate the nail plate.

It should be noted that 85 % of the diabetic patients who showed a positive fungal finding were within the age range from 35 to 80 years.

An interesting observation was the correlation between the level of blood sugar and the percentage of positive fungal findings. In patient with a level of 1500 mg/ml fungi were present in 50 %. At a level of 2000 mg/ml this increased to 60 % while patients with levels above 3000 mg/ml were 100 % affected. Thus it is evident that fungal invasion becomes more prominent with the increase in blood sugar. These findings are in agreement with those of Jolly & Carpenter (3) who reported findings a significant number of patients with abnormal glucose tolerance among their subjects with recurrent *T. rubrum* infection. A correlation may also be seen between the duration of the diabetes and the incidence of fungal invasion since almost 85 % of the affected diabetics had suffered from the disease for more than 5 years.

In the control group of 100 patients (58 females, 42 males) with normal levels of blood glucose microscopic examination of KOH-treated specimens revealed the presence of fungi in 53 and upon culture there was isolation of fungi in 40 cases. Mild signs of presumed mycotic infection were observed in 66 of these non-diabetic subjects. The fungi isolated included: *T. rubrum* in 57,5 %, *T. mentagrophytes* in 35 %, *C. albicans* in 5 % and *E. floccosum* in 2,5 %. It was observed that some 60 % of the case in which *T. mentagrophytes* was isolated showed no significant pathologic skin changes at the site investigated. In this respect it is of interest that McGinnis et al. (5) in their mycotic survey of the toe-webs of 27 volunteers found that 4 of the 7 patients from whom *T. mentagrophytes* had been recovered had no history of tinea pedis. Also of note was the lower percentage of *C. albicans* in the non-

diabetic subjects in our study. Marples (4) had stated that *C. albicans* may be a resident of the toe-webs without necessarily inducing obvious pathological changes. Somerville (7) reported an incidence of 3 % *C. albicans* in elderly persons.

Thus our observations indicate that both the toe-webs and toe-nails of diabetic patients are more susceptible to infection with *C. albicans* than those of non-diabetic subjects. As for the prevalence of dermatophytes at these sites, both *T. rubrum* and *T. mentagrophytes*, and particularly the latter, were found to be present in a higher percentage of subjects with normal blood sugar levels.

In the *in vitro* test of the sensitivity of *T. rubrum*, *T. mentagrophytes*, *E. floccosum* and *C. albicans* to the various anti-diabetic drugs being received by the diabetic patients (Diabinese, Daolin, DBI and insulin) the only notable result was a moderate fungistatic activity of DBI against *C. albicans*. All the other preparations tested showed no significant antifungal activity. It is of note, however, that 60 % of the diabetic patients in whom a fungous infection was found were receiving insulin therapy. Still we do not feel that the anti-diabetic treatment should be considered to play a role in the development of fungous infections in these patients.

Résumé

100 malades avec diabète et 100 sujets sains ont été examinés au point de vue mycologique, en vue d'observer la présence des champignons pathogènes dans les espaces interdigitaux des pieds et dans les ongles des orteils. Des signes suggérant une invasion fongique dans ces endroits ont été trouvés chez 73 des malades avec diabète et chez 66 des non-diabétiques. L'examen microscopique des squâmes et des ongles a mis en évidence la présence des éléments fongiques chez 70 malades du premier groupe et chez 53 du lot témoin. L'agent causal a pu être isolé dans 57 cas du groupe diabétique et dans 40 groupe contrôle. Une corrélation intéressante a été observée entre le taux du sucre et le pourcentage des résultats positifs. *C. albicans* a été trouvé dans une proportion mineure chez les sujets non-diabétiques. La sensibilité *in vitro* des agents isolés vis-à-vis des préparations anti-diabétiques utilisées n'a montré qu'une action antifongique insignifiante.

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