

PREVALENCE OF TOENAIL ONYCHOMYCOSIS AMONG DIABETICS AT A PRIMARY CARE FACILITY IN MALAYSIA*

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Abstract. Onychomycosis increases the risk of developing secondary bacterial infection and cellulitis if left untreated. The aim of this study was to determine the prevalence of onychomycosis among diabetics and its associated factors. A cross sectional study using universal sampling of all type 1 and 2 diabetic patients attending a primary care facility of the Universiti Kebangsaan Malaysia (UKM) from January to March 2011 was conducted. Samples were taken from clinically abnormal nails and from the first right toenail in the absence of nail abnormalities and cultured for fungal elements. A total of 151 diabetics participated in the study. The mean patient age was 60.7 ± 9.1 years. A total of 123 nail samples (81.5%) were culture positive for fungal elements. A positive correlation was found between onychomycosis and increasing age ($p=0.011$) and clinically abnormal nails ($p<0.05$). There were no significant correlations with gender, ethnic group, duration of diabetes, types of diabetes or glycemic control. The prevalence of onychomycosis among diabetics in our study was high.

Keywords: diabetes, fungal infection, onychomycosis, toenail, Malaysia

INTRODUCTION

Diabetes is a growing problem worldwide with an estimated prevalence of 300 million by 2025 (Kafaie and Noorbala, 2010). The term onychomycosis refers to

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the infection of the nail bed and plate by fungi. It is responsible for 30% of cutaneous mycotic infections and almost half of all nail diseases (Mügge *et al*, 2006; Kaur *et al*, 2008). Nail discoloration, thickening, separation of the nail plate from the nail bed, subungual hyperkeratosis and dystrophy are common manifestations of onychomycosis (Fitzpatrick *et al*, 2000). It is a common cause of nail deformity and is frequently encountered in primary care. Diabetics are almost three times more likely to develop onychomycosis compared to those without diabetes (Gupta *et al*, 1998). Onychomycosis not only causes cosmetic problems but increases the risk of secondary bacterial infection contributing to lower limb cellulitis (Cathcart

et al, 2009). Diabetics with onychomycosis are also more likely to develop foot ulceration and amputation (Winston and Miller, 2006).

Risk factors for onychomycosis include immunosuppression, peripheral arterial disease, peripheral neuropathy and increasing age (Thomas *et al*, 2010). Onychomycosis is more common among the elderly, males and diabetics although the exact pathophysiology is unclear (Gupta *et al*, 1998; Dogra *et al*, 2002). It has been postulated, a defect in the carbohydrate metabolism and immunity is a predisposing factor for onychomycosis (Chang *et al*, 2008). Onychomycosis is 2.5 to 3 times more common among males and diabetics (Gupta *et al*, 1998; Dogra *et al*, 2002). Toenails may be more prone to onychomycosis due to defective blood circulation, especially in the elderly. Walking bare foot, use of public facilities, such as gyms, spas, saunas or places of worship also increases the risk for fungal infection (Thomas *et al*, 2010). The aim of this study was to determine the prevalence of onychomycosis among diabetics attending a primary care facility and the factors associated with this condition.

MATERIALS AND METHODS

We conducted a cross sectional study using universal sampling of diabetic patients attending the primary care facility of UKM from January to March 2011. Nail samples for fungal culture were obtained from all subjects. Sampling was taken from the toenails, since onychomycosis occurs more often in toenails than fingernails (Gupta *et al*, 1998; Dogra *et al*, 2002). Nail samples were taken from clinically abnormal nails and from the first right toe nails of patients without any nail abnormalities using standard techniques. This

included cleaning of the nail and nail folds using 70% alcohol prior to sample collection. Small pieces of nail plate clippings and sub-ungual debris were collected in a clean paper envelope and sent to the microbiology lab for processing within 2 hours (Chaya and Pande, 2007). Patients on oral antifungal medication during the previous 3 weeks or who used topical antifungal nail lacquer were excluded from the study. Samples were examined microscopically and cultured on Sabouraud agar. The most recent blood HbA1C level within the previous 3 months was retrieved from the patient's medical records.

Statistical analysis was performed using the Statistical Package for Social Science (SPSS) version 19.0 (SPSS, Chicaco, IL). The prevalence of onychomycosis was determined. The chi-square test was used for categorical data and the Student's *t*-test was used for continuous data. The level of significance was set at $p < 0.05$. This study was approved by the ethics committee of the UKM. Patients with nail abnormalities and having a positive fungal culture were diagnosed as having onychomycosis and were offered treatment at the primary care facility. Clinically normal appearing nails with a positive fungal culture were subjected to repeat culture to exclude contamination.

RESULTS

A total of 151 patients participated in this study. The age range of participants was 37 to 88 years with a mean age of 60.7 ± 9.1 years. Most participants (96.7%, $n=146$) had type 2 diabetes mellitus. More than half of participants (58.9%, $n=89$) had at least one clinically abnormal toenail, while the rest (41.1%, $n=62$) were normal. The majority of nail samples sent for culture (81.5%, $n=123$) were positive

Table 1
Results of nail culture.

Culture results	No. (%)
Positive culture	123 (81.5)
Non-dermatophyte mould	60 (39.7)
Yeast and yeast-like organisms	31 (20.5)
Mixture of organisms	31 (20.5)
Dermatophytes	1 (0.7)
Negative culture	28 (18.5)
Total	151 (100)

for fungal elements. The first toenail was more frequently involved (69.1%, $n=85$) than the other nails, but this was not statistically significant. The majority of the nails studied among participants with type 2 diabetes mellitus (80.8%, $n=118$) were culture positive for onychomycosis and all 5 patients with type 1 diabetes were affected. More than half of clinically normal nails (69.3%, $n=43$) were culture positive for fungi.

Non-dermatophyte mould was the most common fungal element isolated (39.7%, $n=60$), followed by yeast (20.5%, $n=31$) and dermatophytes (0.7%, $n=1$) (Table 1). More females (52.0%, $n=64$) than males (47.9%, $n=59$) had onychomycosis. The majority of patients (78.8%, $n=119$) had their HbA1C level tested and most (78.9%, $n=94$) had poor glycemic control (HbA1C $\geq 6.5\%$). A positive correlation was noted between the presence of onychomycosis and advancing age ($p=0.011$) and clinically abnormal nails ($p<0.05$). However, there was no significant correlation with gender, ethnic group, type of diabetes, duration of diabetes, or HbA1C level and the presence of onychomycosis (Table 2).

DISCUSSION

The prevalence of onychomycosis

among diabetics confirmed by culture was 81.5% ($n=123$). This is higher than earlier studies where the prevalence ranged from 17 to 30% (Dogra *et al*, 2002; Chang *et al*, 2008). In the present study the prevalence of onychomycosis was nearly equal between males and females. Some studies have reported onychomycosis more common among males and other studies have found no difference in gender distribution (Gupta *et al*, 1998; Saunte *et al*, 2006; Chang *et al*, 2008; Kafaie and Noorbala, 2010). In this study, age greater than 61 years was significantly associated with presence of onychomycosis. Other studies have also reported a higher prevalence of onychomycosis among the elderly (Gupta *et al*, 1998; Saunte *et al*, 2006; Chang *et al*, 2008).

There were no associations between glycemic control and duration of diabetes and the presence of onychomycosis in our study. Studies looking at the association between glycemic control and the prevalence of onychomycosis have conflicting results (Chang *et al*, 2008; Kafaie and Noorbala, 2010). This could be due to the different cut-off values for HbA1C or different laboratory measures used in these studies, since these methodological details were not provided. In our study, a HbA1C $>6.5\%$ was considered as poor glycemic control. The duration of poorly controlled glucose at onset of onychomycosis or fluctuating glucose levels may serve as better predictors than a single glucose reading. Although the majority of participants with onychomycosis had diabetes for an average of 8 years, there was no significant association between duration of diabetes and prevalence of onychomycosis. A similar finding was found by Kafaie and Noorbala (2010).

The most frequently isolated fungal element in this study was non-dermatophyte mould (39.7%, $n=60$), similar to an

Table 2
Demography and factors associated with onychomycosis.

Patient characteristics	Affected by onychomycosis		<i>t</i>	<i>p</i> -value
	Yes	No		
Mean age	61.6 ± 9.3	56.8 ± 6.9	2.58	0.01
Mean duration of diabetes(years)	8.2 ± 7.7	6.8 ± 4.1	0.98	0.32
	Onychomycosis, No. (%)			
	Yes	No	χ^2	<i>p</i> -value
Gender				
Male	59 (80.8)	14 (19.2)	0.03	0.84
Female	64 (82.1)	14 (17.9)		
Ethnic group				
Malay	77 (84.6)	14 (15.4)	2.82	0.42
Chinese	27 (73.0)	10 (27.0)		
Indian	17 (80.9)	4 (19.1)		
Others	2 (100)	0 (0)		
Diabetes				
Type 1	5 (100)	0 (0)	1.17	0.27
Type 2	118 (80.8)	28 (19.2)		
HbA1C (<i>n</i> =119)				
<6.5	23 (92.0)	2 (8.0)	3.79	0.15
≥6.5	77 (81.9)	17 (18.1)		
Test not done	23 (71.9)	9 (28.1)		
Toenail				
Normal	43 (69.4)	19 (30.6)	10.20	0.001
Abnormal	80 (89.9)	9 (10.1)		
Affected toenail				
First toenail	85 (79.4)	22 (20.6)	0.99	0.32
Others	38 (86.4)	6 (13.6)		

earlier study among the general population with clinically abnormal nails (Ng *et al*, 1999). Other studies have shown yeasts and dermatophytes as common pathogens isolated from diabetics with onychomycosis (Gupta *et al*, 1998; Manzano-Gayosso *et al*, 2008). This is probably because other factors, such as environment, level of humidity and repeated contact with water influences the growth of particular fungi (de Berker, 2009). In the present study, diabetics with clinically normal nails also

harbored fungal pathogens. However, this finding was not statistically significant.

The medical management of onychomycosis requires prolonged medication use due to the slow growth of nails. Oral antifungal agents have potential side effects, such as drug induced hepatitis. Hence, confirmation of a diagnosis through culture and identification of the pathogen is required to differentiate poor response from treatment failure (Roberts *et al*, 2003). Onychomycosis in diabetics

may be associated with diabetic foot ulcers, cellulitis and gangrene. These complications increase rates of hospital admissions and surgical interventions. Early diagnosis and adequate medical management of onychomycosis among diabetics using oral antifungals may be more cost effective than treating the complications arising from delayed diagnosis and treatment.

A limitation of this study was onychomycosis among diabetics and non-diabetics in the same environment was not compared.

There was a high prevalence of onychomycosis among diabetics (81.5%) in our study. Since onychomycosis is associated with a higher risk of complications among diabetics, physicians should actively examine the feet for onychomycosis during routine consultation.

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