Fusarial onychomycosis – an unrecorded report from Jammu district (India)
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Abstract: Fusarium species which are well known as plant pathogens and soil saprophytes have a worldwide distribution now emerged as major opportunistic fungal agents. Several species of Fusarium have reported to cause superficial and subcutaneous infections, such as onychomycosis and keratomycosis, in humans. To stress the need to identify correctly and institute appropriate antifungal therapy in newly emerging human fungal infectious agents. Repeated mycological sampling of the nails of the suspected fungal infection were processed as per the standard format including direct microscopy and fungal culture on Sabouraud’s dextrose agar. We report eight cases of onychomycosis caused by five different species of Fusarium i.e Fusarium solani (3), Fusarium verticilloides (1), Fusarium proliferatum (1), Fusarium pallidoroseum (2) and Fusarium chlamydosporum (1) from district Jammu, J&K. These species were isolated from both toenail and fingernail infection in all cases. The clinical appearance of the affected nails was total and distal subungual hyperkeratosis followed by onycholysis with white, yellow and brown coloration. The eight cases reported here suggest that Fusarium spp. should be taken into consideration in the differential diagnosis of fungal nail infection.

Keywords: Onychomycosis, nail samples, Clinical signs, Fusarium species, Jammu.

I. INTRODUCTION

The present paper explores the association of different species of Fusarium as causal agents of onychomycosis in Jammu district (India). Onychomycosis is defined as a chronic fungal infection of toenails and fingernails leading to the gradual degradation of nail unit including the nail plate, nail matrix and nail bed. It represents 18 to 40% of all onychopathies and 39% of all superficial mycotic infections (1,2). Frequently it is caused by dermatophytes but now non-dermatophytic moulds are known to account for 2-12% of nail infections (3). The most important non-dermatophytic moulds causing onychomycosis include species of Alternaria, Aspergillus, Cephalosporium, Fusarium, Nattrassia and Scopulariopsis (3-5).

Fusarium species are commonly soil saprophytes and plant pathogens but some of them are able to cause diseases in insects, reptiles, turtles and can also cause a variety of human infections including onychomycosis and foot infections (6,7). Fusarial infections are characterized by the occurrence of white superficial lesions, but recently deep tissue infection and disseminated infections have greatly increased in patients with immunosuppressive conditions (8). In addition, close contact with soil, walking barefooted or with sandals, frequenting swimming pools and condition of trauma are regarded as predisposing factors for the development of onychomycosis and other infections due to Fusarium species (9).

During exploration of onychomycosis in Jammu district, five species of Fusarium detected as causal agents. Here we report the eight cases of onychomycosis caused by F. solani, F. verticilloides, F. pallidoroseum, F. proliferatum and F. chlamydosporum.

II. CASE REPORTS

Nail clippings and scrapings from suspected individuals were collected and were processed by preparing a wet mount of nail sample in 20% potassium hydroxide (KOH) in dimethyl sulphoxide (DMSO) and then counterstained by chlorazol black E to enhance the visualization of the fungus. All the samples were cultured irrespective of the negative or the positive direct microscopic examination on Sabouraud dextrose agar (SDA) medium supplemented with chloramphenicol and incubated at 28-30°C for 21 days. Repeated mycological sampling was done to identify the causal agent correctly. Detection of different Fusarium species was done by growing them on potato sucrose agar medium and by studying their cultural and morphological
characters. Identification was done by following Booth (1971). Identity of some of the *Fusarium* species was also confirmed from Agharkar Research Institute, Pune (India).

**A. Case 1, 2 and 3**

Pathology of case 1, 2 and 3:

- **Case 1** of onychomycosis was detected in a 35 year old women who noticed symptoms first on the nail plate of left big toe. The nail was thickened, deformed, white to pale, showing nail bed hyperkeratosis. All these symptoms suggest a case of distal lateral subungual onychomycosis.

- **Case 2** of onychomycosis was detected in a 60 year old women who noticed symptoms first on the nail plate of left big toe. The nail was thickened, deformed, white to pale, showing nail bed hyperkeratosis. All these symptoms suggest a case of total dystrophic onychomycosis.

- **Case 3** of onychomycosis was detected in a 62 year old man who noticed symptoms first on the nail plate of left big toe. The patient is immunosuppressant suffering from cancer. The nail was thickened, deformed, pale to brown, showing nail bed hyperkeratosis and onycholysis. All these symptoms suggest a case of total dystrophic onychomycosis.

**Mycology of case 1, 2 and 3**

Direct microscopic examination of the nail samples was detected to be negative. However, the nail samples cultured on SDA medium yielded a non-dermatophytic fungus, whose colonies on PSA attained a diameter of 4-5 cm in 4 days, dense floccose, white to cream; reverse brown in colour. Conidiophores branched, monophialidic; microconidia abundant, ovoid to oblong, 0-1 septate, measuring 8.0-16.3 x 2.0-2.8 μm; macroconidia abundant, thick-walled, formed on short multibranched conidiophores, 3 septate, measuring 25.0-53.2 x 3.2-5.0 μm, with pedicellate foot cell. Chlamydospores were present in culture after 10-12 days of incubation. Based on the above features, the isolate was identified as *Fusarium solani* in all the three cases (Fig. 1).

**B. Case 4**

Pathology: Case 4 of onychomycosis was detected in a 16 year old male student who noticed symptoms first on the nail plate of left finger thumb. The nail was thickened, deformed, white to pale, showing nail bed hyperkeratosis. All these symptoms suggest a case of leukonychia striata.

Mycology: Direct microscopic examination of the nail sample was negative, but the nail sample cultured on SDA medium yielded a non-dermatophytic fungus, whose colonies on PSA attained a diameter of 3 cm in 4 days, dense and delicately floccose, white to violet in colour. Conidiophores were simple, lateral, formed on short lateral branches. Microconidia abundant, formed in chains, fusiform to clavate, occasionally one septate, measuring 4.8-11.2 x 1.6-2.4 μm. Macroconidia were not observed in this isolate. Based on the above features, the isolate was identified as *Fusarium verticilloides* (Fig. 2).
C. Case 5
Pathology: Case 5 of onychomycosis was detected in a 45 year old man who noticed symptoms first on the nail plate of all fingers of left hand. Infection began from the distal end and then spreads to the lateral sides of the nail infecting the whole finger nails. The nails were thickened, deformed, hard, pale to brown in colour, showing nail bed hyperkeratosis and onycholysis. All these symptoms suggest a case of distal subungual onychomycosis.

Mycology: Direct microscopic examination of the nail sample was negative, but the nail sample cultured on SDA medium yielded a non-dermatophytic fungus, whose colonies on PSA attained a diameter of 3.5-5.0 cm in 4 days, dense and delicately floccose, creamish peach in colour. Conidiophores were branched and polyphialidic. Microconidia borne in short chains on polyphialides, 0-septate with flat base, measuring 1.9-11.2x0.8-3.2 μm. Macroconidia sparse on branched conidiophores, 1-septate, cylindrical and fusiform, measuring 9.6-11.2x1.6-3.2 μm. Based on the above features, the isolate was identified as *Fusarium proliferatum* (Fig. 3)
D. Case 6 and 7
Pathology of case 6 and 7:
Case 6 of onychomycosis was detected in a 19 year old male student who noticed symptoms first on the nail plate of big toe nail of left foot. The nail was thickened, deformed, hard, pale to brown in colour, showing nail bed hyperkeratosis but no onycholysis. All these symptoms suggest a case of distal subungual onychomycosis.

Case 7 of onychomycosis was detected in a 15 year old male student who noticed symptoms first on the nail plate of thumb nail of left hand. The nail was thickened, deformed, hard, pale to white, showing nail bed hyperkeratosis. All these symptoms suggest a case of total dystrophic onychomycosis.

Mycology of case 6 and 7:
 Direct microscopic examination of the nail sample was negative, but the nail samples cultured on SDA medium yielded a non-dermatophytic fungus, whose colonies on PSA covered whole Petri plate in 5-7 days, floccose, white with peach tinge and ultimately buff brown; reverse brown with peach tinge. Conidiophores were loosely branched and polyphialidic. Microconidia borne in short chains on polyphialides, 0-septate, measuring 15.2-19.6x2.4-3.2μm. Macroconidia sparse, formed from aerial mycelium, 3-5 septate, curved, apex pointed, measuring 14.4-24x2.4-3.2 μm. Chlamydospores present. Based on the above features, the isolate was identified as Fusarium pallidoroseum in both the cases (as shown in Fig.4).

E. Case 8
Pathology: Case 8 of onychomycosis was detected in a 54 year old man who noticed symptoms on the nail plate of thumb nail of right hand. The nail was thickened, deformed, hard, pale to white in colour, showing superficial white lesions, nail bed hyperkeratosis followed by onycholysis suggest a case of distal subungual onychomycosis.

Mycology: Direct microscopic examination of the nail sample was negative but the nail sample cultured on SDA medium yielded a non-dermatophytic fungus, whose colonies on PSA covered whole Petri plate in 5-7 days, produced pinkish, floccose colonies. Microconidia one celled, clavate, oblong to fusiform, borne directly on short and narrow phialides on sympodially proliferating polyphialidic conidiophores measuring, 7-11x1.4-2.1μm, Canoe-shaped macroconidia 2-5 septate, measuring 12.6-30x1.6-2.8 μm were present, Intercalary, smooth, brown-walled chlamydospores were abundantly produced which were mostly globose and formed in short chains, The colony reverse was faintly brown in the beginning but became dark brown as the culture aged due to the increasingly abundant, darkly pigmented chlamydospores. Based on the above features, the isolate was identified as Fusarium chlamydosporum (Fig.5).
V. DISCUSSION

This report shows that the non-dermatophytic moulds are an increasing cause of onychomycosis. The incidence of these infections is probably influenced by environmental conditions as case numbers are increasing in tropical and humid climatic regions[10-14,15,16]. Over the last three decades, an increasing number of nondermatophytic filamentous fungi have also been recognized as agents of skin infections in humans and animals producing lesions clinically similar to those caused by dermatophytes [22-25]. Probably just like dermatophytes, some non-dermatophytic filamentous fungi can also degrade keratin by producing proteolytic enzymes including keratinase[26,27].

Data obtained so far has been tabulated and analysed. As shown in table 1, fusarial nail infection was found to be associated maximum with the farmers of this region. This is probably due to the fact that they are usually working with the soil, which is a reservoir of fusarial species. The second group consisted of the businessmen and students who probably were careless with respect to hygiene. The third occupational group of people that were suffering from onychomycosis consisted of the housewives who did menial household work.

Persual of data given in table 1 shows that among the various age groups, people between the age of 35-62 years showed highest frequency of onychomycosis. This may be due to the less immunity with the increasing age. In addition, it was found that it is more prevalent in males than in the females. It was also observed that among the toe and finger nails that were screened, both were equally prone to fungal infection. Probably this may be due to the fact that both come in direct contact with the soil. During the present investigation, F. solani was isolated in all the cases from toenails. Earlier studies also reported F. solani from toenails[28, 29]. In addition, two types of onychomycosis were diagnosed from the reported eight cases. These included the total and distal lateral subungual onychomycosis. These two types of onychomycosis have been reported earlier also as the most frequent types(11,19). The objective of the present study is to alert the medical community about the relevance of these opportunistic Fusarium species, which have emerged as human infectious agents, emphasizing the importance of correct etiological identification, allowing for appropriate treatment.

Table 1. Clinical and epidemiological characteristics of the eight cases infected by various species of Fusarium

<table>
<thead>
<tr>
<th>Case</th>
<th>Sex</th>
<th>Age</th>
<th>Occupation</th>
<th>Infection sites</th>
<th>Clinical Signs</th>
<th>Evolution Period</th>
<th>Organism Isolated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case1</td>
<td>female</td>
<td>35</td>
<td>Farmer</td>
<td>Toenail</td>
<td>Distal lateral subungual onychomycosis</td>
<td>2 years</td>
<td>F. solani</td>
</tr>
<tr>
<td>Case2</td>
<td>female</td>
<td>60</td>
<td>Housewife</td>
<td>Toenail</td>
<td>Total dystrophic onychomycosis</td>
<td>3 years</td>
<td>F. solani</td>
</tr>
<tr>
<td>Case3</td>
<td>Male</td>
<td>62</td>
<td>Farmer</td>
<td>Toenail</td>
<td>Total dystrophic onychomycosis</td>
<td>3 years</td>
<td>F. solani</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENT

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REFERENCES


<table>
<thead>
<tr>
<th>Case</th>
<th>Male</th>
<th>Student</th>
<th>Fingernail</th>
<th>Leukonychia Striata (A type of Distal lateral subungual onychomycosis)</th>
<th>1 year</th>
<th>F. verticilloides</th>
<th>Distal subungual onychomycosis</th>
<th>F. proliferatum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case 5</td>
<td>male</td>
<td>45</td>
<td>Farmer</td>
<td>Fingernail</td>
<td>Distal subungual onychomycosis</td>
<td>2 years</td>
<td>F. proliferatum</td>
<td></td>
</tr>
<tr>
<td>Case 6</td>
<td>male</td>
<td>19</td>
<td>Student</td>
<td>Toenail</td>
<td>Distal subungual onychomycosis</td>
<td>6 months</td>
<td>F. pallidomucor</td>
<td></td>
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<tr>
<td>Case 7</td>
<td>male</td>
<td>15</td>
<td>Student</td>
<td>Fingernail</td>
<td>Distal subungual onychomycosis</td>
<td>1 year</td>
<td>F. pallidomucor</td>
<td></td>
</tr>
<tr>
<td>Case 8</td>
<td>male</td>
<td>55</td>
<td>Farmer</td>
<td>Fingernail</td>
<td>Distal subungual onychomycosis</td>
<td>2 years</td>
<td>F. chlamydosporum</td>
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