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Original Article

ONYCHOMYCOSIS: UNRAVELING THE ROLE OF DERMATOPHYTES IN NAIL INFECTIONS

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ABSTRACT

Objective: This study aimed to identify pathogenic fungi that cause onychomycosis and evaluate their clinical presentations and risk factors to enhance management through precise diagnosis and targeted treatment.

Methods: The fungi were identified by macroscopic and microscopic morphological features using techniques such as slide cultures, Potassium Hydroxide (KOH) mounts, culture isolation, and Lacto Phenol Cotton Blue (LPCB) staining.

Results: 110 nail clippings from patients clinically suspected of onychomycosis were analyzed; 27 had dermatophytic infections. Toenails were involved in 33.8% of the cases, and Distal and Lateral Subungual Onychomycosis (DLSO) was the primary clinical presentation. Trauma was the most common predisposing factor (19%).

Conclusion: This study identified dermatophytes as the prime cause of onychomycosis, chiefly affecting toenails with DLSO as the predominant form, and recognized trauma as a key risk factor. Precise identification using traditional diagnostic methods is crucial for targeted treatment and better patient results.

Keywords: Onychomycosis, Dermatophytes, Fungal infection, KOH mount, Nail culture

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INTRODUCTION

This study aimed to identify pathogenic fungi that cause onychomycosis and develop treatment strategies for dermatophyte-induced onychomycosis through advanced diagnostics and current treatment analysis. It seeks to enhance awareness and improve diagnostic and treatment protocols, particularly for patients with comorbidities like diabetes and peripheral vascular disease.

Onychomycosis is often a devastating fungal nail infection that mainly affects toenails and fingernails [1]. Dermatophytes, which are fungi that thrive in keratin-rich environments, are the leading causative agents [2]. The incidence of onychomycosis differs globally owing to differences in hygiene practices, climate, and population demographics. It affects 2–18% of the population, making it a significant public health concern [3].

Onychomycosis presents with various clinical symptoms, including nail discolouration, thickening, and dystrophy, as well as infection of the nail and surrounding tissues [4]. Beyond the physical effects, it can also reduce the quality of life. Comorbidities such as diabetes and peripheral vascular disease can complicate management [5].

Diagnosis traditionally involves a combination of clinical evaluation and laboratory tests, such as direct microscopy and culture [6]. The heterogeneity and potential for misdiagnosis present challenges for healthcare professionals [5, 6]. Recent treatment options include topical antifungals, systemic medications, and surgery. Despite advancements in treatment, relapse rates remain high and treatment outcomes are inconsistent [7].

This comprehensive study aimed to elucidate the pathophysiology, epidemiology, and treatment strategies for dermatophyte-induced onychomycosis. By analyzing the current results and trends, we seek to improve the awareness of this rampant condition and contribute to the advancement of more effective diagnostic and treatment protocols.

MATERIALS AND METHODS

Study design

An unblended prospective study was conducted after obtaining ethical approval from the institutional review board (IEC No. 532/l/11/12/Ethics/ESICMC and PGIMSR/Estt. Vol. IV).

Sample collection

Nail clippings from patients showing clinical signs of onychomycosis were collected under sterile conditions.

Inclusion and exclusion criteria

Patients with symptoms such as subungual hyperkeratosis and onycholysis were included, whereas those undergoing antifungal treatment or with nail disorders unrelated to onychomycosis were excluded.

Identification of fungal isolates

Nail clippings were collected and examined using a 10-20% KOH mount to detect fungal elements (fig. 1). The samples were cultured on Sabouraud Dextrose Agar (SDA) with and without cycloheximide, incubated at 25 °C and 37 °C, and colony colour, texture, and shape were observed (fig. 2). LPCB mount was used to study microscopic features and slide cultures were prepared for further analysis [8].

Fig. 1: Blackish discoloration and subungual hyperkeratosis in onychomycosis involving nails of both hands

Fig. 2a: *Trichophyton rubrum*-SDA obverse, reverse

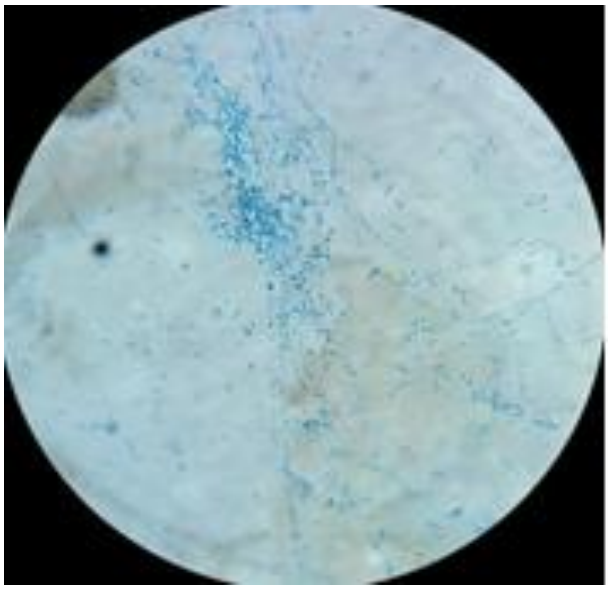

Fig. 2b: *Trichophyton rubrum*-LPCB microscopy

RESULTS

Of the 110 processed samples, 66 were culture-positive: 27 (40.9%) were dermatophytes, 37 (56%) were non-dermatophytes and four (6%) were Candida species. Most patients (60%) were male, with the highest prevalence in the 31-40 age group. Toenail involvement was observed in 52% of cases.

Table 1: Identification and speciation of dermatophytes (n=27)

Dermatophytes (27)	Number	Percentage
Trichophyton rubrum	14	51.85 %
Trichophyton mentagrophytes	7	25.92 %
Trichophyton tonsurans	6	22.22 %

Table 1 shows, that the most commonly isolated dermatophyte was *Trichophyton rubrum* (14, 51.85%), trailed by *Trichophyton mentagrophytes* (7, 25.92%).

Table 2: Distribution of study samples based on clinical features (n=110)

Clinical features	Number	Culture positive (Percentage)
Thickening of the nail plate	40	23 (33.8 %)
Subungual hyperkeratosis	34	20 (29.4 %)
Onycholysis and Discoloration	31	23 (33.8 %)
Total dystrophy of the nail	05	2 (2.9 %)
Total	110	68

The most common clinical presentation was nail thickening (33.8%), followed by subungual hyperkeratosis (29.4%), onycholysis (33.8%), and nail dystrophy (2.9%; table 2).

Table 3: Distribution of samples based on clinical types, KOH positivity, and culture positivity

Clinical types	No of cases	KOH positive cases	Culture positive cases
Distal and Lateral subungual onychomycosis (DLSO)	43 (39%)	21 (48.8%)	27 (62.8%)
Proximal Subungual Onychomycosis (PSO)	29 (26.36)	16 (55.17%)	21 (72.4%)
Total Dystrophic Onychomycosis (TDO)	17 (15.5)	10 (58.8%)	12 (70.5%)
Superficial White Onychomycosis (SWO)	14 (12.7)	3 (21.4%)	6 (42.85%)
Candidal Onychomycosis	7 (6.4)	0	2 (28.5%)
Total	110	50	66

Table 3 shows that the most common clinical presentation was Distal and Lateral Subungual Onychomycosis, accounting for 39% of the cases, followed by Proximal Subungual Onychomycosis (26.36 %). Among the DLSO cases, 21 were KOH positive and 27 were culture positive. In the PSO group, 16 patients were KOH-positive, and 21 were culture-positive.

Table 4: Predisposing factors and co-morbid conditions associated with onychomycosis

Predisposing factors	Percentage	Co-morbid conditions	Percentage
History of Trauma	19%	Diabetes Mellitus	13%
Overuse of Detergents or Water	15%	History of Smoking	11%
Excessive Use of Gloves	13%	Liver/Renal Disease	9%
History of Walking Barefoot	10%	History of organ transplantation or steroid use	9%
History of Contact with Animals	8%	Immunodeficiency	2%
History of Nail Biting	7%	None	35%
None	28%		

Table 4 shows that a history of trauma was the most common predisposing factor, accounting for 19%, followed by excessive exposure to water and detergents at 15%. Among the patients, Diabetes Mellitus was the most prevalent comorbid condition, followed by smoking in 11% of the cases.

DISCUSSION

This study analysed 110 samples of suspected onychomycosis, demonstrating a high culture positivity rate of 60%. Dermatophytes were significant among the culture-positive samples (40.9 %), while non-dermatophyte fungi and Candida species represented the remaining isolates. The predominant dermatophyte was *T. rubrum*, highlighting its difficult role in nail infection. These findings align with Deng *et al.* and Mahmood *et al.*, confirming that *T. rubrum* is the most common causative agent of onychomycosis [9, 10].

The demographic data showed a higher prevalence of male patients (60%), predominantly in the 31-40 age group, indicating that this age range may be more vulnerable to onychomycosis, which is consistent with the findings of Jha *et al.* and Sundarai *et al.* studies [11, 12]. This result could be attributed to aspects such as amplified work exposure or lifestyle choices that increase susceptibility to fungal infections. Additionally, toenail infections were more prevalent (52%), likely because of their anatomical structure and environmental exposure, making them more susceptible to fungal invasion [13].

The primary clinical features associated with onychomycosis in this group were nail thickness, onycholysis, and subungual hyperkeratosis. These findings align with those of the Foley K study, which states that nail discoloration and thickness are typical clinical signs of fungal infections [14]. In line with the findings of the A Muthulatha *et al.* study, our study found that distal and DLSO was the most common clinical type, followed by proximal subungual onychomycosis (PSO) [15]. The significant occurrence of culture positivity in both DLSO and PSO emphasizes the utility of diagnostic cultures in confirming fungal infections.

In addition, predisposing factors were investigated, with a history of trauma (19%) being the most prevalent, followed by the excessive use of water and detergents (15%), which is in agreement with a study by Leung *et al.* [16] These results imply that mechanical damage and excessive moisture play a pivotal role in fungal penetration, which is a crucial factor in the development of onychomycosis. Diabetes mellitus was the most common comorbidity (13%). This result is consistent with that of a study by Trovato *et al.* and supports earlier research that relays diabetes to a higher risk of fungal infections because of a debilitated immune system and reformed nail keratin [17].

Smoking habit (11%) and liver/renal disease (9%), as comorbid conditions, can additionally increase an individual's susceptibility to onychomycosis due to underlying systemic health issues. Similar findings have been reported by Elewski *et al.* [5]; among the participants, 2% had immune deficiencies, indicating that even those with a strong immune system could be affected. These findings highlight the importance of early diagnosis and treatment.

LIMITATIONS OF THE STUDY

The limited sample size may not entirely capture the variety of dermatophytes associated with onychomycosis. Impending studies should aim to include larger and more varied populations to augment our understanding of these infections.

CONCLUSION

Dermatophytes continue to be the leading cause of onychomycosis, emphasizing the importance of accurate diagnosis and treatment. Understanding the epidemiology of these fungi is crucial to develop effective management policies and public health initiatives.

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AUTHORS CONTRIBUTIONS

Conception/design: Dr Md Iqbal Ahmed, Dr Rahil Pasha S A. Provision of study material: Dr Md Iqbal Ahamed, Dr Rahil Pasha S A, Dr Sadiya Noor Hajira, Dr Asmiya Parveen. Collection of data: Dr Md Iqbal Ahamed, Dr Rahil Pasha S A. Data analysis and interpretation: Dr Md Iqbal Ahamed, Dr Rahil Pasha S A, Dr Sadiya Noor Hajira, Dr Asmiya Parveen. Manuscript writing: Dr Md Iqbal Ahamed, Dr Rahil Pasha S A. Final approval of manuscript: Dr. Sadiya Noor Hajira, Dr Asmiya Parveen.

CONFLICTS OF INTERESTS

The authors declared no conflicts of interest concerning the research and/or publication of this article.

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