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Review Article

Onychomycosis: Review

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Abstract

"Onychomycosis" is the most frequent cause of nail diseases, referred to as a general term to denote any fungal nail infection [1]. The increased persasiveness of onychomycosis is likely to occur due to change in demographic characteristics which include relative aging of the population, prevalence of diabetes, peripheral vascular disease, immunosuppression; and extensive iatrogenic and altering in lifestyle practices. Nail infection in humans are mainly caused by three classes of fungi: dermatophytes including *Trichophyton* sps, non-dermatophyte molds, and yeasts which mostly include *Candida* sps [1,2]. Dermatophytes constitute the vast majority of infectious etiologies [3]. In one epidemiological survey, major causal organisms of onychomycosis are dermatophytes followed by *Candida albicans* [4]. It does not usually cure itself and it can trigger more infectious lesions in other parts of the body. Immunocompromised patients and aged population are more likely to be susceptible towards onychomycosis (10% of the general population, 20% of the population aged >60 years, up to 50% of people aged >70 years and up to one-third of diabetic individuals). Care should be taken for the accurate diagnosis and timely treatment of onychomycosis to prevent complications.

Keywords: *Onychomycosis; Dermatophytes; Candida; Trichophyton*

Introduction

Onychomycosis is a mycotic infection of the nails which is prevalent in nail-plates or nail beds, leading to the gradual destruction of the nail plate. Onychomycosis is the premium cause of nail infections and it has been reported that half of the diseased nails are due to fungal infections, out of which 30% are due to cutaneous fungal infections [5]. It can be caused by any opportunistic fungus which may be dermatophytes, yeasts or non-dermatophytic molds [6]. The dermatophytes *Trichophyton rubrum* and *Trichophyton mentagrophytes* are the main causative pathogens, responsible for 80 – 90% of the infections [7-9]. Non-dermatophytic fungi such as *Acremonium* spp., *Alternaria* spp., *Aspergillus* spp., *Fusarium* spp., *Scytalidium* spp. and *Scopulariopsis* spp have been found to be involved in 2–11% of the onychomycosis cases reported. Yeasts, consisting *Candida* spp., account for 2 - 10% of fungal nail infections [5,7-11]. Infected damped floors are the main source of dermatophytic infection and it does not come under the communicable disease. Infectious traumatized nails among aged patients is reported to be the chief cause of non dermatophytic infection [11,12]. As such onychomycosis only harms the nails and is often overlooked considering it as a cosmetic problem, in contrast to foot ulceration due to tinea pedis. Tinea pedis may cause onychomycosis and has been associated with the same in 30 - 59% of the cases [13,14]. Teniapedis is observed to be the second most leading cause of infection among web spaces, toes, nail plates, sole, heel and across the whole foot.

Classification and Etiology

There are four groups of fungi associated with onychomycosis: dermatophytes, non-dermatophytes, molds and yeasts. Varies from one geographic area to another primarily due to different climatic conditions [3].

Distal subungual onychomycosis

The most prevalent type of onychomycosis, Distal Lateral Subungual Onychomycosis (DLSO), is identified as the infection of nail bed and nail-plate by invasion. It is best known as "nail bed dermatophytosis". The infection arises from the anterior site which continues till underlying nail matrix. Mild inflammation develops, resulting in focal parakeratosis and subungual hyperkeratosis [15,16], with two consequences: onycholysis and subungual thickening. The normal appearance of nail is changed which can be seen as keratinized nail bed. The appearance of normal nail shape and colour is lost. The nail plate becomes highly thickened and loses the contact through their original site. DSLO may develop on the fingernails, toenails or both. Dermatophytes are the foremost causative agents of onychomycosis; opportunistic non-dermatophytes can cause infection due to any kind of trauma. *T. rubrum*, *T. mentagrophytes, T. tonsurans* and *E. floccosum* have been reported as the common causal agents of onychomycosis. To study the direct microscopy and isolation of causal agents, the underside of the nail plate and anterior site of the nail is taken as the specimen. Further consequences of DLSO may infect the nail bed which may lead to complete loss of nail-plate.

Proximal subungual onychomycosis

This is also known as Proximal White Subungual Onychomycosis (PWSO) or Proximal Subungual Onychomycosis (PSO). A relatively uncommon subtype, PSO occurs when organisms invade the nail unit via proximal nail fold through the cuticle area, penetrating the newly formed nail plate and migrate distally resulting in subungual hyperkeratosis, proximal onycholysis, leukonychia and destruction of the proximal nail-plate. Proximal nail fold is observed as whitish yellow discolouration of nail-plate due to fungal invasion, while the distal part of the nail persists to be normal. PSO are the symptomatic type and are marked with purulent discharge and pain at the site of infection. It is often misdiagnosed as bacterial infection. Both the fingernails and toenails are equally affected by PSO and are primarily caused by *T. rubrum*; though *T. mentagrophytes* are the rare causal agents have been reported. PSO has been described with increased frequency in patients with Acquired Immuno Deficiency Syndrome (AIDS). The prime cause of the above is still unknown. The specimen should be taken from proximal nail bed and nail-plate as close to lunula as possible. In the most advanced stages of PSO, the shedding of the nail-plate and its gradual destruction is frequently observed.

White superficial onychomycosis

White Superficial Onychomycosis (WSO); a less common variety, is a distinctive pattern in which the nail plate is the primary site of invasion. It is the direct invasion in the superficial layers of the nail-plate, the chief causal agent is *T. mentagrophytes* and sometimes the non-dermatophyte molds like *Acremonium* spp., *Aspergillus terreus* and *Fusarium oxysporum*. The occurence of well-dilated opaque "white islands" on the external side of the nail-plate can be identified as WSO. As the disease spreads, the appearance of nail becomes rough, soft and brittle. No symptoms of inflammation is seen in the WSO type. It occurs primarily in toenails. Immunocompromised patients are highly susceptible towards WSO. The identification and isolation should be done by taking scrapings of the nail plate.

***Candida* onychomycosis**

Candida nail infections arise in the form of mucocutaneous infection and it can be seen in the chronic form of candidiasis. Main causal agent is *C. albicans* (70%); *C. parapsilosis*, *C. tropicalis* and *C. krusei* are also observed in some cases (30%) [19]. Both toe nails and fingernails are equally affected by the same. The organism invades the nail plate directly and has three subtypes:

***Candida* paronychia:** It is the most prevalent subtype and is mainly characterised by swelling and erythema of the proximal and lateral nail folds, commonly called as "whitlow". The infection of the nail matrix becomes chronic with the appearance of transverse depressions (Beau's lines) in the nail plate. Nail-plate appears to be convex, irregular and rough, resulting in dystrophy.

***Candida* granuloma:** This is categorised in one of the most uncommon types and is signified by the thickening of the nail plate and associated paronychia. Immunocompromised patients are highly susceptible to this infection. The organism may affect the entire thickness of the nail, resulting in swelling of the proximal and lateral nail folds until the digit develops a pseudo clubbing or "chicken drumstick" appearance. Specimens are taken from the nail plates and the subungual debris of the infected nail.

***Candida* onycholysis:** The separation of the nail plate from the nail bed is the major cause of this infection. As the disease develops, nail bed appears as yellowish grey mass pushing away the infected nail-plate. The lesion resembles to that seen in patients with DSLO.

Total Dystrophic Onychomycosis (TDO): As the name suggests, the penultimate destruction of the nail plate is seen; it is the worst form of onychomycosis. This affects the complete nail unit resulting in keratinization. TDO is used to describe end-stage nail disease.

Treatment

Onychomycosis is considered as a cosmetic problem showing negative psychological and physical impact on the patient. The consequences of onychomycosis are seen as cellulitis in aged patients and in diabetic patients it may further develop as diabetic foot [17]. Complete cure of onychomycosis means restoration of normal nail growth (at least 4 or 5 mm in 6 months) and no signs of onycholysis, hyperkeratosis, paronychia, discoloration, or fragility [21,4].

Broad spectrum anti-fungal drug is ideal to treat onychomycosis. The treatment provided should be economic with minimal side-effects. Treatment can be categorised as topical, systemic, or a combination of both.

Topical therapy

Topical therapy should not be used if nail penetration is expected to be suboptimal [17]. Nowadays, topical antifungals are comprised of ciclopirox 8% and amorolfine 5% lacquers. Topical therapy requires prolonged treatment for at least 6 months to one year which is considered as a major drawback.

Systemic therapy

Oral therapy is recommended when involvement of > 50% of distal nail plate/ multiple nail involvement, topical drug penetration is expected to be suboptimal. Azoles, griseofulvin, and allylamine terbinafine are the common oral antifungals used to treat onychomycosis [20].

Combination therapy

Despite proven efficacy of oral antifungals, clinical outcome is often far from satisfactory [18]. In an attempt to improve the cure rate and reduce relapse, use of combination therapy has become necessary. Complete penetration of the drug cannot be typically seen in the lateral borders of nail with oral therapy. Oral drugs help to treat the cutaneous infections. Together with oral and topical therapy, onychomycosis may be completely eradicated [19].

Surgical intervention

Surgical methods can be incorporated to treat complicated cases of onychomycosis. Carbon dioxide laser can be used to remove the nails. Surgical distal removal involves painful procedure and carries the risk of infection and abnormal nail regrowth (distal nail embedding) [18]. Fruitful results are observed by the combination of debridement and nail lacquer application. However, some studies did not find encouraging results when surgical nail avulsion for single nail onychomycosis was combined with topical antifungal creams [22].

Conclusion

Onychomycosis is a type of nail infection caused by pathogenic fungi. Nearly half of all nail infections are onychomycotic, making it the most common nail disorder. Onycomycosis can easily be identified by a process which includes clinical examination, direct microscopy and culture. It also helps to distinguish onychomycosis from other type of infections.

Both fingernails and toenails are equally susceptible to fungal infections, but toenails are more commonly affected. There are four types of onychomycosis, Distal subungual onychomycosis, Proximal subungual onychomycosis, White superficial onychomycosis and *Candida* onychomycosis. These are found in different geographic areas primarily due to different climatic conditions. Onychomycosis will rarely improve without medical treatment. Currently available treatments include both oral and topical therapies. But these do not treat

onycomycosis in all cases due to limited efficacy and frequent relapse. Laser treatment is a new treatment which eradicates the fungal infection completely. It involves heating the infected nail bed, the temperature increases to 40°C - 60°C which disrupts fungal growth [23]. Photodynamic therapy is also a new and coming therapy which uses laser or LED light to activate a photosensitizing compound that eradicate fungi [24,25].

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