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Research Article

Clinical predictors of antifungal treatment failure in Dermatophytosis: a microbiological perspective

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Article Info

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Abstract

Background: Chronic, recurrent and difficult-to-treat dermatophytosis has become a significant therapeutic challenge in India. Clinical factors associated with treatment failure may help identify patients requiring reassessment and closer follow-up.

Objectives: To describe the mycological profile of patients with suspected dermatophytosis and assess the association of selected clinical factors with antifungal treatment failure.

Methods: This prospective observational study was conducted over six months in the Dermatology Outpatient Department of a private hospital. One hundred patients with clinically suspected dermatophytosis underwent potassium hydroxide (KOH) microscopy and fungal culture. KOH-positive patients received antifungal treatment and were followed up at two and four weeks. Associations between selected clinical factors and treatment outcome were evaluated using Pearson's chi-square test. Odds ratios (ORs) and 95% confidence intervals (CIs) were calculated.

Results: Of 100 clinically suspected cases, 78 (78%) were KOH-positive and 56 (56%) were culture-positive. *Trichophyton mentagrophytes* was the predominant isolate. Among 78 KOH-positive patients who completed follow-up, 23 (29.5%) experienced treatment failure and 55 (70.5%) responded. Topical corticosteroid use was significantly associated with treatment failure (OR 3.55, 95% CI 1.28–9.88; p = 0.013). Prior antifungal exposure (OR 2.28, 95% CI 0.84–6.13; p = 0.100) and chronic infection lasting more than three months (OR 2.49, 95% CI 0.88–6.98; p = 0.080) showed nonsignificant associations.

Limitations: The study was conducted at a single centre, had a limited sample size and short follow-up, and did not include antifungal susceptibility testing or multivariable analysis.

Conclusion: Topical corticosteroid use was significantly associated with clinical antifungal treatment failure. Clinical nonresponse alone does not establish antifungal resistance.

Keywords: Dermatophytosis; treatment failure; topical corticosteroids; fungal culture; *Trichophyton mentagrophytes*.

Introduction

Dermatophytosis is a superficial fungal infection affecting keratinized tissues, including the skin, hair and nails. The principal causative organisms belong to the genera *Trichophyton*, *Microsporum* and *Epidermophyton*. In India, chronic, recurrent and difficult-to-treat dermatophytosis has become an important clinical concern. Verma and Madhu reviewed the changing epidemiology of superficial dermatophytosis in India, while Dogra and Uprety highlighted the challenges posed by chronic and recurrent disease [1,2]. Panda and Verma also emphasized the need for stronger evidence to understand the changing epidemiological and clinical patterns of dermatophytosis.[3]

Several factors may contribute to treatment failure, including inappropriate antifungal use, inadequate treatment duration, poor adherence, reinfection and indiscriminate use of topical corticosteroid-containing combination preparations. Corticosteroids may suppress inflammation and alter the clinical appearance of fungal lesions, potentially delaying appropriate diagnosis and treatment. The Indian expert consensus on dermatophytosis management strongly discouraged topical corticosteroid use in routine treatment of dermatophytosis [4,5]

Antifungal resistance is an additional concern. Resistance to terbinafine has been associated with mutations in the squalene epoxidase gene in clinical dermatophyte isolates [6,7, 12] However, clinical nonresponse is not synonymous with microbiologically confirmed resistance. Persistent lesions may also reflect inadequate treatment, poor adherence, reinfection, host factors or diagnostic uncertainty [4,5,8,9] Biofilm formation and host–pathogen interactions have also been investigated as possible contributors to fungal persistence [10,11]

KOH microscopy provides a practical method for supporting the diagnosis of dermatophytosis, while fungal culture can assist in identifying the causative organism. Antifungal susceptibility testing may be valuable in selected persistent or recalcitrant cases, but it is not always available in routine clinical settings.[4,5]

Identifying clinical factors associated with treatment failure may therefore help clinicians recognize patients who require closer assessment and follow-up. This study aimed to describe the mycological findings among patients with suspected dermatophytosis and assess the association of topical corticosteroid use, prior antifungal exposure and chronic infection with clinical treatment failure. The study evaluated clinical outcomes and did not attempt to establish microbiologically confirmed antifungal resistance.

Materials and methods

Study design and setting

A prospective observational study was conducted over six months in the Dermatology Outpatient CMR Institute of Medical Sciences, Kandlakoya (V), Medchal Mandal, Hyderabad, Telangana, India.

Study population

A total of 100 patients with clinically suspected dermatophytosis were included. Duration of the study: June 2025 – June 2026

Inclusion criteria: Patients with a clinical diagnosis of dermatophytosis who were willing to participate and provided informed consent.

Exclusion criteria: Patients with dermatoses clinically mimicking dermatophytosis and patients who did not complete the required follow-up.

Clinical assessment

Clinical information was recorded, including disease duration, previous antifungal exposure and history of topical corticosteroid use. Infection lasting more than three months was categorized as chronic for the purpose of analysis.

Mycological examination

Skin scrapings were examined using potassium hydroxide (KOH) microscopy to identify fungal elements. Fungal culture was performed, and recovered isolates were identified using the laboratory procedures employed during the study.

Treatment and follow-up

Patients with positive KOH microscopy results received systemic antifungal treatment selected by the treating clinician. The antifungal agents used included itraconazole, terbinafine and fluconazole. Patients were reviewed at two and four weeks.

Clinical response was assessed based on changes in itching, scaling and lesion size. Response was categorized as complete when clearance was at least 90%, partial when clearance was at least 50% but less than 90%, and minimal when clearance was less than 50%. Patients with no response or worsening were also identified.

Clinical treatment failure was defined as minimal or absent improvement, worsening of lesions, development of new lesions or recurrence documented within the four-week follow-up period. This outcome represented clinical response and was not considered microbiological confirmation of antifungal resistance.

Study variables

The following factors were assessed for association with treatment failure:

1. Topical corticosteroid use.
2. Prior antifungal exposure.
3. Chronic infection lasting more than three months.

Statistical analysis

Categorical variables were summarized as frequencies and percentages. Associations between clinical factors and treatment outcome were assessed using Pearson's chi-square test without continuity correction. Odds ratios and 95% confidence intervals were calculated from the corresponding 2 × 2 contingency tables. A p-value of less than 0.05 was considered statistically significant.

Ethical considerations

The study was conducted after obtaining Institutional Ethics Committee approval. Informed consent was obtained from participating patients.

Results

KOH microscopy and fungal culture

Among the 100 patients with clinically suspected dermatophytosis, 78 (78%) were positive by KOH microscopy. Fungal culture was positive in 56 patients (56%). *Trichophyton mentagrophytes* was the predominant fungal isolate.

Clinical treatment outcome

Of the 78 KOH-positive patients included in the treatment analysis, all completed the scheduled follow-up. Clinical treatment failure occurred in 23 patients (29.5%), whereas 55 patients (70.5%) responded to treatment.

Association between clinical factors and treatment failure

The associations between selected clinical factors and treatment outcome are presented in Table 1.

Clinical factor	Treatment failure (n = 23), n (%)	Responders (n = 55), n (%)	OR (95% CI)	p-value
Topical corticosteroid use	15 (65.2)	19 (34.5)	3.55 (1.28–9.88)	0.013
Prior antifungal exposure	13 (56.5)	20 (36.4)	2.28 (0.84–6.13)	0.100
Chronic infection (>3 months)	10 (43.5)	13 (23.6)	2.49 (0.88–6.98)	0.080

Table 1. Association of selected clinical factors with antifungal treatment failure

OR: odds ratio; CI: confidence interval. P-values were calculated using Pearson's chi-square test without continuity correction.

Topical corticosteroid use was significantly associated with treatment failure (OR 3.55, 95% CI 1.28–9.88; p = 0.013). Prior antifungal exposure was associated with higher estimated odds of treatment failure, but this association was not statistically significant (OR 2.28, 95% CI 0.84–6.13; p = 0.100). Chronic infection lasting more than three months also showed higher estimated odds of treatment failure, without

reaching statistical significance (OR 2.49, 95% CI 0.88–6.98; p = 0.080).

Discussion

This study found that 29.5% of KOH-positive patients experienced clinical treatment failure during four weeks of follow-up. The principal finding was a statistically significant association between topical corticosteroid use and treatment failure. Prior antifungal exposure and chronic infection showed nonsignificant associations.

The association between topical corticosteroid use and treatment failure is consistent with concerns described in Indian studies of chronic and recurrent dermatophytosis[1,2,4,5]. Corticosteroid-containing preparations can suppress inflammation and itching without adequately treating the underlying fungal infection. Their inappropriate use may modify lesion morphology, delay recognition and contribute to persistent or extensive disease. The ECTODERM India consensus specifically discouraged topical corticosteroid use in the management of dermatophytosis.[5]

In the present study, topical corticosteroid use was associated with 3.55-fold higher odds of clinical treatment failure. This finding represents an association rather than proof of causation. Disease severity, previous treatment practices, adherence and the adequacy of the prescribed regimen may also have influenced outcomes.

Prior antifungal exposure was associated with higher estimated odds of treatment failure, although the association was not statistically significant. Previous treatment may reflect several circumstances, including inadequate duration, poor adherence, inappropriate drug selection or persistent disease despite treatment. The available data do not establish which of these circumstances applied to individual patients.

Chronic infection lasting more than three months also showed higher estimated odds of treatment failure. Chronicity may reflect delayed diagnosis, inadequate treatment, reinfection or other factors affecting clinical response. Although chronic infection lasting more than three months was associated with higher odds of treatment failure (OR 2.49, 95% CI 0.88–6.98; p = 0.080), the association was not statistically significant. Therefore, chronicity could not be established as a statistically significant predictor of treatment failure in the present study.

Antifungal resistance is an important consideration in recalcitrant dermatophytosis. Singh and colleagues reported terbinafine-resistant *Trichophyton interdigitale* isolates from India associated with mutations in the squalene epoxidase gene.[6] Rudramurthy and colleagues also reported squalene epoxidase gene mutations associated with allylamine resistance in *Trichophyton interdigitale* and *Trichophyton rubrum*.[7] These studies establish that resistance can occur, but they do not demonstrate that every patient who fails treatment has a resistant infection.

The Indian epidemic of superficial dermatophytosis attributed to *Trichophyton mentagrophytes* has also been investigated using molecular methods[9]. Research into dermatophyte biofilms and host–pathogen interactions provides additional biological context for persistent infection.[10,11] Nevertheless, these mechanisms cannot be inferred from clinical outcomes alone.

Fungal culture was performed in the present study, but antifungal susceptibility testing was not undertaken. Consequently, the observed treatment failures cannot be attributed directly to antifungal resistance, and no conclusions can be drawn about the susceptibility profile of the recovered isolates. The findings instead identify clinical factors associated with treatment outcome that may help inform clinical assessment and future investigations.

Limitations

This study has several limitations. First, the sample size was limited to 100 clinically suspected cases from a single hospital, which may limit generalizability. Second, follow-up was

restricted to four weeks, limiting assessment of long-term recurrence. Third, systemic antifungal regimens were selected by the treating clinician and included different agents; differences in drug selection, dose, duration, adherence and disease severity may have influenced outcomes. Fourth, the analysis was based on unadjusted associations, and potential confounding factors were not controlled through multivariable analysis. Finally, antifungal susceptibility testing was not performed; clinical treatment failure therefore cannot be equated with confirmed antifungal resistance.

Conclusion

Topical corticosteroid use was significantly associated with clinical antifungal treatment failure among patients with KOH-positive dermatophytosis in this study. Prior antifungal exposure and chronic infection lasting more than three months showed nonsignificant associations. These findings emphasize the importance of documenting corticosteroid use and previous treatment practices when assessing patients with persistent dermatophytosis. As antifungal susceptibility testing was not performed, the observed treatment failures should not be interpreted as confirmed antifungal resistance. Larger prospective studies incorporating standardized treatment protocols, longer follow-up and antifungal susceptibility testing are needed to clarify the factors contributing to persistent dermatophytosis.

Declarations

Ethical Approval

The study was conducted after obtaining approval from the Institutional Ethics Committee of CMR Institute of Medical Sciences, Kandlakoya, Medchal Mandal, Hyderabad, Telangana, India

Informed Consent

Written informed consent was obtained from all participating patients before enrolment in the study.

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Conflict of Interest

The authors declare no conflict of interest.

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Data Availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request, subject to institutional and ethical requirements.

Use of Artificial Intelligence

The authors used AI-assisted tools solely for grammatical correction, language refinement, and improving the readability of the manuscript. AI tools were not used to generate research data, perform statistical analyses, interpret results, or draw scientific conclusions. The authors take full responsibility for the accuracy, originality, and integrity of the manuscript.

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