A PRELIMINARY SURVEY OF DERMATOMYCOSES IN BANGALORE

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ABSTRACT

Clinical and mycological investigations were made on 225 cases of suspected dermatomycoses. Of these, 102 were microscopically positive. But only 63 were culturally positive, and these are analysed here with regard to clinical patterns and aetiological species, age, sex and occupational incidence and susceptibility to griseofulvin in vitro. As in most other parts of India, Trichophyton rubrum was the dominant species. A high proportion of Epidermophyton floccosum was an unusual feature seen. Of the clinical types, tinea cruris was the most common. The isolates were sensitive to griseofulvin at low concentrations of 1 to 5 μg per ml of agar medium, E. floccosum being the most sensitive.

INTRODUCTION

The study of dermatophytes in India had started as early as the 1920's, mainly at the Calcutta School of Tropical Medicine. All the references pertaining to this early work may be found in one of the Editorials of the Indian Medical Gazette, 1952.

Recent studies consist mainly of surveys of the incidence of the various causal species and clinical types in different parts of the country. From Southern India, there are such reports from Tamil Nadu (Klokke et al., 1966; Klokke and Durairaj, 1967), Andhra Pradesh (Govindan Nair, 1942; Vasu, 1966; Nagabhushanam et al., 1969) and Kerala (Kurup and Anantha-narayanan, 1961). Since no data are available regarding dermatomycoses in Mysore State, we present here the results of a preliminary survey conducted by us.
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**Materials and Methods**

The survey was made mainly at the skin (out-patient) department of the Bowring and Lady Curzon Hospital, Bangalore. A few cases were seen at St. Martha's Hospital. Over a total period of 8 months, a total of 214 cases from the former, and 11 cases from the latter hospital, of suspected dermatomycoses, were examined. The tentative clinical diagnosis was based on the following features: (a) appearance of the lesion; (b) long duration of the lesion; (c) failure to heal by the common antibacterial preparations, and (d) failure to heal, or a flare-up, following corticosteroid therapy. The last three features were indicated by the case-history. The patients were not only from Bangalore City, but also from neighbouring villages or towns. Infections of the mucous membrane, and tinea versicolor of the skin, though frequently seen, were not included in this survey.

Scrapings were collected with a clean scalpel on a clean paper. Initially, the lesion was cleaned with 70 per cent alcohol before scrapping, but this practice was later given up as no extra advantage was obtained from it. Only in such cases where the lesion was dirty as in the feet, or where some medicament had been applied, cleaning was done prior to scrapping.

The scrapings were later dispensed into sterile Petri dishes. Some of the scales were mounted in a drop of KOH-Glycerine (KOH—10 g, dissolved in 90 ml of distilled water and shaken up with 10 ml of glycerine) on a slide, covered with a coverslip and left overnight before microscopic examination.

For culturing, molten agar medium was cooled to 45°C and poured into the Petri dish containing the scales, and the latter dispersed by gentle shaking. The Petri dishes were incubated at 30°C. The composition of the medium was a modification of Sabouraud-cycloheximide-chloramphenicol medium (Ajello et al., 1963) as follows:

- Dextrose, 25 g;
- Peptone, 10 g;
- Yeast extract, 1 g;
- Agar, 25 g;
- Water, 1,000 ml;
- Chloromycetin, 25 mg in 10 ml ethyl alcohol;
- Cycloheximide, 200 mg in 10 ml acetone.

The antibiotic solutions were added to the hot medium after sterilization.

Initially, some scales were also inoculated into slants of the same medium, but since these did not always yield cultures, this practice was soon given up. The pour plate method gave good results.

Colonies of dermatophytes which appeared on the plates were retained until sporulation occurred, and then examined and identified after Rebell et al. (1964). After examination, they were transferred to slants of the same
medium without antibiotics, on which they were maintained. The few which did not sporulate were transferred to rice agar (Rice, 20 g; Agar, 20 g; Water, 1,000 ml) in slide cultures for sporulation.

For in vitro testing with Griseofulvin, the following method was used; Griseofulvin powder was dissolved in 5 ml of dimethyl formamide and made up to 10 ml with sterile water. Serial dilutions were made from this in sterile water and incorporated into sterilized and cooled agar medium (Dextrose, 40 g; Peptone, 10 g; Yeast extract, 1 g; Agar, 20 g; Water, 1,000 ml; pH 6.5) to give concentrations ranging from 0.1 to 20 µg/ml of agar. The medium was poured in petri dishes. The plates were streaked with standard inocula of the test fungi, so as to give 10,000 spores or mycelial fragments per streak. For control, the maximum concentration of the solvent obtained in the test plates was incorporated in the agar. The plates were incubated at 30°C, read after intervals of 7 and 14 days and rated visually. The plates were in duplicates, and the experiment was repeated.

**RESULTS**

A day-to-day analysis showed that, of the total number of people attending the skin clinic, 2 to 35 per cent (average 16 per cent) gave a clinical appearance of fungal infection. Of these, 3 to 17 per cent (average 5 per cent) could be definitely shown to be of fungal origin by microscopy and culture. Of the 225 suspected cases, only 63 were culturally proven to be caused by known dermatophytes or *Candida albicans*. Altogether 64 cultures were obtained from these 63 cases, one being a case of mixed infection yielding two fungi. However, as shown by Table I, a large number of cases was

**Table I**

*Results of microscopic and cultural examination of skin scales from suspected cases of tinea*

<table>
<thead>
<tr>
<th>Microscopic</th>
<th>Positive</th>
<th>Culture</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fungal hyphae seen</td>
<td>Spherical or budding cells, no hyphae</td>
</tr>
<tr>
<td>1. 123</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>2. ..</td>
<td>40</td>
<td>..</td>
</tr>
<tr>
<td>3. ..</td>
<td>62</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong> 123</td>
<td>102</td>
<td></td>
</tr>
</tbody>
</table>
microscopically positive, i.e., showing fungal hyphae, or yeast or chlamydo-
spore-like elements. But since these did not yield known dermatophytes
in cultures, they were not considered in further analyses. A large number
of saprophytic fungi and yeasts were obtained in many cases. The more
common of these fungi are listed below.

Asperillus spp., Penicillium spp., Hormodendrum spp., Syncodalstrum
sp., Scopulariopsis sp., Alternaria sp., Mucor sp., Curvularia sp., Helminthos-
porium sp., Chrysosporium sp., Cephalosporium sp.; Sterile mycelia-several
types.

Sometimes, some of these fungi grew as the sole organisms from the
scales, suggesting an aetiologicaI role. This was particularly true of Cephalo-
sporium sp. which was cultured in three instances from tinea corporis, tinea
pedis and tinea unguium respectively. When inoculated on the shaven and
scarified skin of the flanks of guinea-pigs, however, none of the isolates
produced any lesions, even with an inoculum of 10 million spores/ml.

Clinical Types and Aetiological Species

The aetiology of different kinds of tinea is shown in Table II. It may
be seen that T. rubrum is the most common aetiological agent, causing tinea
cruris as well as corporis, followed by E. floccosum, C. albicans and T. mentagro-
phycites in that order, the first and third species causing tinea cruris as well as
corporis, and C. albicans, mainly tinea cruris and pedis. T. violaceum is
found mainly to cause tinea capitis in children. In one child, a mixed in-
fection with T. violaceum and an unidentified Trichophyton (T. ferrugineum)
was found.

Of the clinical types, tinea cruris is the most common, followed by tinea
corporis and then tinea pedis. The term tinea corporis is used here to designate
lesions in any part of the body including the face, while tinea cruris refers
only to lesions of the groin. In tinea pedis, two clinical types were found:
one, the typical 'athlete's foot', with sodden lesions between the toes; the
second, fissurous or scaly lesions on the soles, particularly along the edges.
This was usually associated with similar lesions on the hands.

Clinical and Microscopic Pattern in Relation to Aetiological Species

An attempt was made to see if the clinical picture and the microscopic
appearance of the fungus in the skin gave any clue to the causal species. In
studying the clinical appearance, the following features were noted:
(a) single or multiple lesions, (b) extent of lesion, (c) pigmentation, i.e., hyperpigmented, hypopigmented or reddish, (d) elevation, i.e., raised or flush with the surface, (e) margin, i.e., irregular, clearly defined, raised, etc., (f) scaling, i.e., degree of scaling, large or small scales, etc. With regard to microscopic appearance, the following points were considered:

(a) hyphae or chlamydospore-like cells, abundant or scanty; (b) if hyphae, long or short, straight or undulate, continuous or breaking into arthrospores.

**TABLE II**

*Analysis of causal organisms involved in different clinical types*

<table>
<thead>
<tr>
<th>Causal species</th>
<th>Clinical types</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>t. cruris</td>
<td>t. corporis*</td>
</tr>
<tr>
<td><strong>Trychophyton rubrum</strong></td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td><strong>T. mentagrophytes</strong></td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td><strong>T. violaceum</strong></td>
<td>..</td>
<td>1</td>
</tr>
<tr>
<td><strong>T. ferrugineum</strong></td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td><strong>Epidermophyton floccosum</strong></td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td><strong>Candida albicans</strong></td>
<td>4</td>
<td>..</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>33</td>
<td>15</td>
</tr>
</tbody>
</table>

* Includes facial lesions also; † 6 cultures from 5 cases.

All these clinical and microscopic features were found in various different combinations in each species, and no single pattern could be made out at the common one for any species. Generally in most cases, however, the lesions were single in tinea cruris and multiple in tinea corporis, extensive, being over 10 cm wide, hyperpigmented, with a well-defined margin, and scaly. The different kinds of microscopic appearance outlined above were seen in roughly equal proportions. Thus with the existing data, no correlation could be established between the clinical or microscopic appearance on the one hand, and the species of fungus involved on the other.
**Age, Sex and Occupational Incidence**

The different clinical types were examined in relation to age, sex and occupation of the patients, and the results are presented in Tables III, IV and V.

**Table III**

*Analysis of different clinical types in relation to age*

<table>
<thead>
<tr>
<th>Clinical types</th>
<th>Age in years</th>
<th>10 and below</th>
<th>11-20</th>
<th>21-30</th>
<th>31-40</th>
<th>41-50</th>
<th>51 and above</th>
</tr>
</thead>
<tbody>
<tr>
<td>t. cruris</td>
<td></td>
<td>7</td>
<td>17</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>t. corporis</td>
<td></td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>t. pedis</td>
<td></td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>t. capitis</td>
<td></td>
<td>4</td>
<td>1</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>t. unguium</td>
<td></td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>1</td>
<td>..</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>7</td>
<td>11</td>
<td>21</td>
<td>8</td>
<td>9</td>
<td>7</td>
</tr>
</tbody>
</table>

**Table IV**

*Analysis of different clinical types in relation to sex*

<table>
<thead>
<tr>
<th>Clinical types</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>T. cruris</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>T. corporis</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>T. pedis</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>T. capitis</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>T. unguium</td>
<td>1</td>
<td>..</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>17</td>
</tr>
</tbody>
</table>
TABLE V

*Analysis of different clinical types in relation to occupation*

<table>
<thead>
<tr>
<th>Clinical types</th>
<th>Occupation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students</td>
</tr>
<tr>
<td>t. cruris</td>
<td>3</td>
</tr>
<tr>
<td>t. corporis</td>
<td>3</td>
</tr>
<tr>
<td>t. pedis</td>
<td>1</td>
</tr>
<tr>
<td>t. capitis</td>
<td>5</td>
</tr>
<tr>
<td>t. unguium</td>
<td>..</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
</tr>
</tbody>
</table>

* Includes office workers, businessmen, artisans and other manual labourers at random.

As seen from the tables, tinea cruris is the most common condition in men, while tinea corporis, and tinea of the hands and feet are more common in women. Among men, the largest number of cases are from the age group of 21 to 30, and mainly students and factory workers. Tinea capitis is the most common condition in children below 10 years.

In vitro *Susceptibility to Griseofulvin*

The minimum inhibitory concentration (mic) of Griseofulvin for various isolates is presented in Table VI. Inhibition refers to complete inhibition, i.e., no growth even at the end of 14 days. As seen in the Table, there is a slight difference between species in their Griseofulvin sensitivity, *E. floccosum* being the most sensitive and *T. mentagrophytes* and *T. violaceum* least so.

*Therapy.*—Initially, antiseptic or antifungal preparations such as Dermoquinol 4% (East India Pharmaceuticals), Multifungin (Boehringer-Kroll), Jadit (Hoechst), or Whitefield ointment were prescribed for topical application. If no improvement was seen after a week, as was often the case, patients were put on Griseofulvin (fine-particle) at 500 mg per day for a minimum of one month. Most of the patients improved sufficiently with
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this treatment. A few patients who showed recurrence were put on a further course of Griseofulvin. Only two patients failed to improve with Griseofulvin. Patients with tinea pedis were very slow to improve, and they were given vitamin A in addition. However, since most of the cases were not available for a complete follow-up, no figures can be given.

**TABLE VI**

*Minimum inhibitory concentrations (mic) of Griseofulvin in vitro for the various isolates tested*

<table>
<thead>
<tr>
<th>Species</th>
<th>Strain No.</th>
<th>Isolated from</th>
<th>mic of Griseofulvin (µg/ml. of agar)</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Trichophyton rubrum</em></td>
<td>IS 146</td>
<td>t. cruris</td>
<td>4</td>
</tr>
<tr>
<td>do.</td>
<td>IS 149</td>
<td>t. corporis</td>
<td>4</td>
</tr>
<tr>
<td><em>T. mentagrophytes</em></td>
<td>IS 152</td>
<td>t. cruris</td>
<td>5</td>
</tr>
<tr>
<td>do.</td>
<td>IS 157</td>
<td>t. corporis</td>
<td>5</td>
</tr>
<tr>
<td><em>T. violaceum</em></td>
<td>IS 200</td>
<td>t. capitis</td>
<td>5</td>
</tr>
<tr>
<td>do.</td>
<td>IS 206</td>
<td>T. do.</td>
<td>5</td>
</tr>
<tr>
<td><em>Epidermophyton floccosum</em></td>
<td>IS 171</td>
<td>t. cruris</td>
<td>2</td>
</tr>
<tr>
<td>do.</td>
<td>IS 174</td>
<td>t. corporis</td>
<td>2</td>
</tr>
<tr>
<td>do.</td>
<td>IS 175</td>
<td>t. pedis</td>
<td>1</td>
</tr>
<tr>
<td><em>Candida albicans</em></td>
<td>IS 168</td>
<td>t. cruris</td>
<td>No inhibition even at 20</td>
</tr>
<tr>
<td>do.</td>
<td>IS 189</td>
<td>t. pedis</td>
<td>do.</td>
</tr>
</tbody>
</table>

**DISCUSSION**

The widespread occurrence of dermatomycoses in the tropics is well known. Our survey indicates that they are very common in this area, but often not correctly diagnosed or treated.

The addition of yeast extract to the modified Sabouraud's agar, and the use of Petri dishes instead of test-tube slants, gave better growth and good sporulation of fungi.
As regards microscopic examination, we have found that leaving the preparation overnight in 10% KOH-glycerine gives good results. A saturated solution of sodium sulphide has been used with good results by Ghosh et al. (1948).

The finding of *T. rubrum* as the dominant aetiological agent of ringworm is in conformity with reports from other parts of India. It is generally agreed that *T. rubrum* is well adapted to living in the human skin. Here it may be of interest to mention that one of us has isolated *T. rubrum* from a soil sample (Indira, 1968). At that time, the identity of the fungus was not known, and it was simply described as *Trichophyton* sp.

Of special interest is the high proportion of *E. floccosum* which we have encountered. In India, a high proportion of this fungus has been reported only from Bengal (Ghosh, 1948). In most other regions where surveys have been made, *T. mentagrophytes* takes the second place.

We have seen only 5 cases of tinea capitis in the course of our investigations. This may not mean that the condition is rare here. It is more likely that this condition is prevalent in boarding schools and orphanages rather than in children living with their parents and children of the former group did not usually come to the hospital where the material was collected. In fact, two out of our 5 cases were children from an orphanage. It might be of interest to make a survey of tines capitis in such orphanages, as Klokke has done (Klokke et al., 1966).

Attempts have often been made to correlate the clinical picture in dermatomycoses with the aetiological species (Khan and Anwar, 1969). In our studies we have found no such correlation. Variations from the typical pictures are seen in all the species involved. It is more likely that the different types of clinical picture are expressions of variable resistance offered by the individual's skin to the dermatophyte (Desai, 1959). The species can be recognized only by culture.

The age-incidence of tinea cruris between 21 and 30 years (Table IV) is similar to that in other reports (Khan and Anwar, 1969, 20–25 years; Mankodi and Kanvinde, 1969, 11–30 years). The predominance of tinea cruris in men may be attributed to excessive sweating, and abrasion from undergarments. As may be seen from Table V, most of the patients in this group were factory workers, especially mechanics, who generally have to do heavy manual work and hence sweat profusely. In women, the com-
monest location for tinea corporis was over the waist, where extensive hyperpigmented lesions were found, usually extending over the inframammary areas. This could be attributed to the kind of clothing. In India, most women wearing sarees wear it very tight at the waist. The abrasion and sweating resulting from this may predispose the skin to infection. Tenia of the feet in men was usually seen in those wearing closed shoes and socks, where a microclimate favourable for fungal growth is usually created. Acton and McGuire (1927) have described the predisposing conditions for tinea cruris as thinness of the skin, surface moisture as in obese people, friction by clothing and shoes, and constant wetting of hands and feet.

Table IV shows that a majority of the patients were students. The high percentage of students among patients may be attributed either to the particular susceptibility of the age-groups of 11 to 30 years, or to a greater tendency among the student population to seek medical aid.

The minimum inhibitory concentrations of Griseofulvin in vitro for dermatophytes varies with each report, but generally it is within 5 µg/ml for most species in agar media, which is in conformity with our findings and much less in liquid media (Hildick-Smith et al., 1964; Verma, 1965).

While Griseofulvin is found satisfactory in most cases, it is very expensive and often causes side reactions, mainly headache, hence not always practicable. The search should still continue for an effective non-irritant topical therapeutic agent.

ACKNOWLEDGEMENTS

We are grateful to the authorities of the Bowring and Lady Curzon Hospital and of St. Martha’s Hospital, Bangalore, for permission to make these investigations; to Dr. D. G. Davey of the Imperial Chemical Industries, Ltd., U.K., for a gift sample of Griseofulvin. The senior author (PUI) thanks the authorities of the Indian Institute of Science for the award of a Research Associateship.

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