In Vitro Susceptibilities of Isolates of *Sporothrix schenckii* to Itraconazole and Terbinafine

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Thirty isolates of the yeast form of *Sporothrix schenckii* were evaluated for in vitro susceptibility to itraconazole and terbinafine by the recommended NCCLS modified technique (M27-A2). The MICs of itraconazole obtained oscillated between 0.062 and 4.0 μg/ml, and those of terbinafine oscillated between 0.007 and 0.50 μg/ml; therefore, terbinafine showed greater in vitro activity.

Sporotrichosis is a subacute or chronic infection affecting both animals and humans and is characterized by nodular cutaneous and subcutaneous lesions, which may involve the adjacent lymphatic system, which suppurates and drains (1, 20).

Itraconazole is currently considered the treatment of choice to treat the diverse clinical manifestations of sporotrichosis (13, 14, 17, 18). On the other hand terbinafine by virtue of its excellent in vitro and in vivo activity is under comparative evaluation for its therapeutic potential for a wide range of fungal infections (4, 6, 8, 11, 21, 22).

Promising in vitro results with terbinafine for both the fixed and the lymphocutaneous forms of sporotrichosis due to the fungus *Sporothrix schenckii* (10, 11, 21) are being compared and confirmed clinically (4, 8, 10, 19).

In this study, our objective was to determine the in vitro efficacy of terbinafine against isolates of *Sporothrix schenckii* by the technique of macrodilution in a liquid medium (NCCLS M27-A2) (15) adapted for dimorphic fungi.

Thirty strains of *Sporothrix schenckii*, including 2 reference isolates (ATCC 201679 and M527-88), 18 human clinical isolates, and 10 animal isolates (9 from cats and 1 from a horse) were included in this study. All the samples were isolated from clinical specimens, identified by micromorphological characteristics and demonstration of typical dimorphism. They were maintained in brain heart infusion (BHI) solid medium–0.5% glucose by successive passages in BHI solid medium and incubation at 35°C. Quality control (QC) strains *Candida krusei* (ATCC 6258) and *Candida parapsilosis* (ATCC 22019) were tested in parallel and were inhibited by MICs at the correct range for the antifungal tested (itraconazole) (15). The MIC range of terbinafine for the QC *Candida* strains has not yet been established by the NCCLS.

Susceptibility tests were conducted using a technique of macrodilution in a liquid medium in accordance with the NCCLS protocol (M27-A2) (15), adapted for dimorphic fungi to include a 5-day incubation period to compensate for the sluggish growth of the yeast phase of *Sporothrix schenckii*, which requires 5 days to reach exponential growth (3, 7) and the addition of glucose to the medium (20 g/liter). The inoculum was prepared spectrophotometrically (520 nm, 60% of transmittance) to reach approximately 1 × 10⁶ to 5 × 10⁶ CFU/ml at an incubation temperature of 35°C.

The drugs itraconazole (Janssen Pharmaceutical, Beerse, Belgium) and terbinafine (Novartis Research Institute, Venice, Austria) were obtained in their pure form, dissolved in dimethyl sulfoxide, and prepared at a 10× concentration in RPMI 1640 (GIBCO).

Before being added to test tubes the suspensions were diluted to 1:100 and 1:20 in the RPMI 1640-2% glucose to reach a final concentration of 0.5 × 10³ to 2.5 × 10³ CFU/ml. Samples of 0.1 ml of the drugs at each concentration were transferred to 12- by 75-mm test tubes, in duplicate, to which were added 0.9 ml of the inoculum previously prepared in a spectrophotometer (520 nm, 60% T). The samples of diluted drugs were subjected to a range of 0.007 to 4.0 μg/ml. All assays were performed in triplicate.

All tubes were incubated at 35°C under constant agitation in a thermoshaker (Gerhardt, Königswinter, Germany) for 5 days. The MICs were read and checked visually for inhibition of fungal growth by approximately 80% in relation to growth in control tubes, where 100% of growth was visualized.

The MICs of itraconazole obtained for the human clinical isolates oscillated between 0.062 and 4.0 μg/ml, and those of terbinafine oscillated between 0.007 and 0.50 μg/ml. With respect to the animal isolates, itraconazole yielded consistent results of 4.0 μg/ml for all the cat samples and a value of 0.062 μg/ml for the horse isolate and terbinafine yielded values between 0.007 and 0.125 μg/ml for both cat and horse isolates (Table 1).

For itraconazole the MICs reported here are in agreement with the literature, which reports low levels of resistance for cells of *Sporothrix schenckii* to this antifungal drug (3, 5, 9, 14). It should be emphasized that the values obtained for the iso-
lates from cats indicated resistance to itraconazole. This was attributed to the high frequency of serious forms with systemic dissemination of sporotrichosis among cats, and, because of the scarce data available on the use ofazole derivatives in the treatment of animal sporotrichosis, no comparison of the data obtained here was possible (2, 16).

In relation to terbinafine no references in the current literature to in vitro activity against the yeast form of Sporothrix schenckii were found. However, some references made mention of the mycelium phase (11, 21).

In the present study, we are able to report the extreme susceptibility of all human and animal isolates of Sporothrix schenckii to terbinafine. The data reveal its potent in vitro activity against the yeast cells of Sporothrix schenckii, which is in agreement with the available literature, although with reference to other fungi. The potential in vivo therapeutic value of terbinafine has been confirmed, up to the present, only for cases of cutaneous and lymphocutaneous sporotrichosis (8, 11, 19, 21), although the use of elevated doses of the drug have been suggested (above 500 mg day⁻¹) to ensure clinical efficacy (4). Efficacy has not been observed with the use of terbinafine for the treatment of systemic sporotrichosis in the murine model (12). There is an obvious need for further studies to correlate the in vitro susceptibility tests with the clinical response of patients with various clinical forms of sporotrichosis.

We thank Novartis Research Institute (terbinafine) and Jansen Pharmaceutical (itraconazole) for providing the drugs in their pure form. We also thank Jacqueline Travassos de Mello and Maria Ferreira Verardo (Hospital Universitário de Juiz de Fora, Minas Gerais, Brazil) for providing 10 samples used in this study.

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**REFERENCES**


**TABLE 1. Susceptibilities of 30 isolates of Sporothrix schenckii to itraconazole and terbinafine, including QC strains of Candida**

<table>
<thead>
<tr>
<th>Species and group of isolates (n) or strain</th>
<th>Antifungal agent</th>
<th>MIC (µg/ml)</th>
<th>% Resistant isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. schenckii</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Animal (10)</td>
<td>Itraconazole</td>
<td>0.062–4.0</td>
<td>90</td>
</tr>
<tr>
<td>Human (20)</td>
<td>Terbinafine</td>
<td>0.007–1.125</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. krusei ATCC 6258 (QC)</td>
<td>Itraconazole</td>
<td>0.125–0.5</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Terbinafine</td>
<td>4.0–&gt;4.0</td>
<td>100</td>
</tr>
<tr>
<td>C. parapsilosis ATCC 22019 (QC)</td>
<td>Itraconazole</td>
<td>0.125–0.25</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Terbinafine</td>
<td>0.25–0.50</td>
<td>0</td>
</tr>
</tbody>
</table>

*50% and 90%. MICs at which 50 and 90% of isolates, respectively, are inhibited.

**a** Only one susceptible isolate, from a horse.