Abstract: Oral geotrichosis is an uncommon opportunistic infection caused by Geotrichum candidum, a habitual contaminant and component of the flora of various parts of the body. This communication reports both a 20-year retrospective study of clinically and mycologically proven cases of oral geotrichosis, and a prospective study of fungal oral flora in 200 individuals divided into two groups: normal individuals and individuals with associated conditions. Twelve patients with proven oral geotrichosis were included: 9 females and 3 males, with a mean age of 48.5 years; the associated conditions were diabetes mellitus (66.6%), leukemia, Hodgkin’s lymphoma and HIV/AIDS infection. The oral geotrichoses showed three clinical varieties: pseudomembranous (75%), hyperplastic, and palatine ulcer. G. candidum was isolated in 11 cases and G. capitatum in one. Positive fungal cultures were obtained from the two groups, and 48% and 78% of cultures were positive, respectively, for Candida spp. In 2.8% and 6.33% of the cases, G. candidum was isolated, respectively, together with one strain of G. capitatum. Oral geotrichosis is an exceptional infection that clinically presents, and is treated, as oral candidiasis. G. candidum may be isolated from the oral flora of a small proportion of individuals or those with associated conditions. (J Oral Sci 52, 477-483, 2010)

Keywords: oral geotrichosis; Geotrichum candidum; Geotrichum capitatum; Candida albicans; diabetes; leukemia.

Introduction

Geotrichosis is an infrequent opportunistic mycosis caused by yeasts. The main etiologic agent is Geotrichum candidum, which belongs to the class Hemiascomycetaceae, order Saccharomycetales, family Dipodascaceae. It has been reported to pathologically affect the bronchi, lungs, and bowel, and only seldom the mouth, skin and nails. Two other species have also been reported to affect the lung: Geotrichum capitatum and Geotrichum clavatum (1-4).

G. candidum is a cosmopolitan microorganism and habitual contaminant. It has been isolated from various sources such as fruits and vegetables, soil, and plants. Several studies have proven that it is a commensal in humans and part of the normal flora of the skin, mouth and gastrointestinal tract (3). G. candidum has been isolated from 29% of fecal samples (5,6), and from 18-31% of more than 2,000 specimens of sputum, feces, urine and vaginal discharge. No studies specifically aimed at isolating Geotrichum spp. from the normal oral flora have been reported.

Most of the reported clinical cases have occurred in immunosuppressed patients or immunosuppressive disorders, and have affected the respiratory tract (bronchi and lungs); superficial skin infections and, recently, invasive infections have also been reported (7-9). In earlier reports we described cases of oral geotrichosis associated with diabetes mellitus (4,10).

Here we present a retrospective report of cases of oral
geotrichosis we have experienced, as well as details of a study of this habitual contaminant in normal subjects and patients with various conditions. Our principal aim was to present a case series and detail the clinical behavior of the disease, as well as the diagnostic mycological aspects, in order to document the most effective techniques not only for oral cases, but also deep and systemic infections. Our secondary aim was to demonstrate the presence of Geotrichum spp. as a habitual contaminant in healthy individuals and patients with several diseases.

**Materials and Methods**

Retrospective study of proven cases of oral geotrichosis

Our report covers a 20-year (1989-2008) retrospective survey of proven cases of oral geotrichosis. The medical history of the patients was taken, and mycologic tests were performed, including direct KOH (20%) and cotton blue stain, and cultures using the following routine media: Sabouraud dextrose agar (Difco™ Inc., Seneca, KS, USA), yeast extract agar plus chloramphenicol (Difco™ Inc.), and Biggy-Nickerson agar (Difco™ Inc.). The resulting organisms were identified based on their micro- and macro-morphologic features, and proven by biochemical tests (carbohydrate utilization) using the commercial method, API-yeast 20® (Biomérieux Inc., Durham, NC, USA).

Study of the fungal flora

For this study, 200 individuals were selected, and divided into two groups with age- and gender-matching.

Group 1. This comprised 100 normal subjects who were disease-free, had no associated conditions or immunodeficiency, and were not receiving treatment with either steroids or topical or oral antibiotics.

Group 2. This comprised 100 patients with conditions such as type-1 and type-2 diabetes mellitus (both controlled and uncontrolled), hematological cancers (leukemia and lymphoma), HIV/AIDS, and drug-related immunosuppression (oral steroids and cytostatic agents). None of the patients had any oral conditions. An oral specimen was taken by smearing three sterile swabs on the tongue, the palatine aspect of the cheeks and the palate. Each of the swabs was seeded in three types of culture media using the streaking technique: Sabouraud dextrose agar (Difco™ Inc.), +, yeast extract (Difco™ Inc.), + chloramphenicol agar, and CHROMagar Candida™ (CHROMagar™, Paris, France).

The resulting cultures were identified based on their micro- and macromorphologic features, and proven by biochemical tests (carbohydrate utilization) using the commercial method, API-yeast 20® method.

**Results**

Retrospective study of oral geotrichosis

Twelve cases of clinically and mycologically proven

<table>
<thead>
<tr>
<th>No.</th>
<th>Gender</th>
<th>Age</th>
<th>Duration Days</th>
<th>Associated conditions</th>
<th>Clinical forms</th>
<th>Direct exams and stains</th>
<th>Cultures</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>48</td>
<td>8</td>
<td>T2-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>58</td>
<td>8</td>
<td>ALL-2</td>
<td>Palatine ulcers</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>44</td>
<td>12</td>
<td>T2-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae</td>
<td>G. candidum</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>52</td>
<td>6</td>
<td>T2-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>31</td>
<td>5</td>
<td>T2-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae</td>
<td>G. candidum</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>33</td>
<td>8</td>
<td>HIV-AIDS</td>
<td>Vilious hyperplastic</td>
<td>Septate hyphae</td>
<td>G. candidum</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>48</td>
<td>12</td>
<td>T1-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>43</td>
<td>8</td>
<td>T2-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
<tr>
<td>9</td>
<td>M</td>
<td>52</td>
<td>15</td>
<td>Hodgkin’s lymphoma</td>
<td>Pseudomembranous + angular cheilitis</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>38</td>
<td>12</td>
<td>T2-DM</td>
<td>Vilious hyperplastic</td>
<td>Septate hyphae</td>
<td>G. candidum</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>72</td>
<td>6</td>
<td>T2-DM</td>
<td>Pseudomembranous</td>
<td>Septate hyphae</td>
<td>G. candidum</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>63</td>
<td>5</td>
<td>ALL-2</td>
<td>Pseudomembranous</td>
<td>Septate hyphae + arthroconidia</td>
<td>G. candidum</td>
</tr>
</tbody>
</table>

T2-DM = Type 2 diabetes mellitus; T1-DM = Type 1 diabetes mellitus; ALL-2 = Type 2 acute lymphoblastic leukemia
Geotrichosis were included. Table 1 shows the main demographic, clinical and mycologic data. Nine of the 12 patients (75%) were females and the rest were males. The youngest patient was 31 years old and the oldest was 72; mean age was 48.5 years. The disease course was: the minor case of 5 days, and the major one of 15 days, with a mean duration of 8.75 days. Associated conditions included 8 cases of diabetes mellitus (66.6%) (type 2, 7 cases; type 1, 1 case), 2 cases of type-2 acute lymphocytic leukemia (ALL-2), one case of Hodgkin’s lymphoma, and one case of HIV infection/AIDS. All the patients enrolled were being followed up and treated for their respective conditions.

With regard to the clinical variety, 9 patients (75%) had the pseudomembranous form with primary involvement of the tongue; one of them also had associated angular cheilitis (Table 1, Figs. 1-3).

Mycologically, all the cases showed fungal elements; 8 (66.6%) of them had thin, septate hyphae with rectangular arthroconidia and, at times, rounded borders (clavata cells), while in the remaining 4 cases (33.4%), only thin and septate hyphae were evident. White villous and wet colonies grew in all cases, and under the microscope these were seen as having abundant thin, septate filaments with multiple rectangular arthroconidia. Eleven cultures were biochemically identified as *G. candidum*, with the resulting carbohydrate assimilation of glucose and xylose, and were negative for galactose, cellobiose, lactose, maltose, melibiose and saccharose. No growth occurred at 40°C, and a strain identified as *G. capitatum* produced glucose, galactose and xylose, and was negative for cellobiose, maltose and saccharose; growth occurred at 40°C (4,11) (Figs. 4, 5).

Fig. 1 Pseudomembranous form, affecting basically the tongue (Patient 7, Table 1).

Fig. 2 Villous hyperplastic manifestation (Patient 6, Table 1).

Fig. 3 Palatal ulcer. The arrow indicates the initial ulcer (Patient 2, Table 1).

Fig. 4 *Geotrichum candidum* in Sabouraud dextrose agar (white and villous colony).
Study of the fungal flora

The results of the flora study in the two groups, normal individuals and those with associated conditions, are shown in Table 2. Overall, 48% of the cultures were positive in the first group, with Candida spp. predominant and only one isolate of G. candidum (2.8%) being obtained. In the second group, 79% of the cultures were positive, with Candida spp. predominant. There were 5 isolates of G. candidum (6.33%), specifically from 4 patients with controlled type-2 diabetes, and one with controlled chronic myelocytic leukemia. One isolate of G. candidum (1.26%) was obtained from one patient with type-2 diabetes mellitus.

Discussion

Ciferri and Redaelli were the first to report cases of geotrichosis in 1935. All were skin infections, and the authors also carried out a study of the normal flora and isolated Geotrichum from sputum and skin. Some cases reported in the late 20th century seem to have been geotrichosis (1,3). We have observed cases involving the skin, lungs, bowel and, specifically, two cases of oral geotrichosis (2,4,10).

G. candidum is a yeast with a teleomorphic status known as Galactomyces geotrichum (11,12). It is considered to have low virulence, and is even used regularly for the maturation of cheese (Brie type) and is a contaminant of water and milk. However, it may result in severe disease when associated with immunosuppressive conditions or treatments (3,7,8). G. capitatus is the second medically important species; it also has a teleomorphic state known as Dipodascus capitatus (12), and has been reported to cause bowel, bronchial, lung and disseminated infections, as well as fungemias (9,13-16).

We reported oral geotrichosis for the first time in 1987 (10), and since then have experienced a series of cases on which this clinical mycologic report is based. Most of the cases (75%) showed pseudomembranous manifestations, that is, involvement mainly of the tongue resulting in glossitis, and in some cases the disease affected the palatal area of the cheeks. All cases presented as easily removable pseudomembranous, creamy, whitish plaques with an erythematous background. In one of the patients, the condition was associated with angular cheilitis; this was the case showing the greatest degree of progression, indicating that greater chronicity may include involvement of the mouth adnexa, i.e., the lips. The most common symptoms were burning pain and impaired swallowing. On the basis of the clinical features, this entity is

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Table 2 Study of the habitual fungal flora of the mouth

<table>
<thead>
<tr>
<th>Group 1. Normal individuals (n = 100)</th>
<th>Group 2. Patients with a condition and under treatment (n = 100)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Candida albicans</strong></td>
<td><strong>Candida albicans</strong></td>
</tr>
<tr>
<td><strong>Candida tropicalis</strong></td>
<td><strong>Candida glabrata</strong></td>
</tr>
<tr>
<td><strong>Candida glabrata</strong></td>
<td><strong>Candida tropicalis</strong></td>
</tr>
<tr>
<td><strong>Candida krusei</strong></td>
<td><strong>Candida krusei</strong></td>
</tr>
<tr>
<td><strong>mixed</strong></td>
<td><strong>Candida parapsilosis</strong></td>
</tr>
<tr>
<td><strong>C. albicans + C. glabrata</strong></td>
<td><strong>Candida dublinensis</strong></td>
</tr>
<tr>
<td><strong>C. albicans + C. krusei</strong></td>
<td><strong>Mixed:</strong></td>
</tr>
<tr>
<td><strong>Geotrichum candidum</strong></td>
<td><strong>C. albicans + C. glabrata</strong></td>
</tr>
<tr>
<td><strong>Geotrichum capitatum</strong></td>
<td><strong>C. albicans + C. krusei</strong></td>
</tr>
<tr>
<td><strong>Trichosporon asahii</strong></td>
<td><strong>Geotrichum candidum</strong></td>
</tr>
<tr>
<td><strong>Total cultures</strong></td>
<td><strong>Geotrichum capitatum</strong></td>
</tr>
</tbody>
</table>

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Fig. 5 Geotrichum candidum, direct examination (cotton blue, ×40).
indistinguishable from pseudomembranous candidiasis, and in fact this was the presumptive diagnosis in all cases. Although there have been only a few reports of oral geotrichosis, some have resembled the clinical picture in our patients. The presentation is usually one of erythema with whitish plaques, similar to oral candidiasis; both *G. candidum* and *G. capitatum* have been reported as the causative agents (16-19).

Two cases with a villous hyperplastic manifestation, similar to viral disease and candidiasis, drew our attention. These cases demonstrated that, if a routine mycologic study is not performed, and the isolated organisms not properly identified, oral geotrichosis may easily be diagnosed as candidiasis. Therefore, we think that geotrichosis may be more common than generally assumed, and in fact frequently misdiagnosed, mainly because it responds well to treatment aimed at candidiasis. One of our patients had a very distinct clinical presentation of a small localized ulcer on the hard palate; this was an immunosuppressed patient with type-2 acute lymphoblastic leukemia. This clinical manifestation was very different from candidiasis, which is more superficial, and bore a close resemblance to ulcers caused by zygomycosis and aspergillosis, resulting in a very aggressive palatine-cerebral condition with a poor prognosis (20). This has been reported for some patients (19) with esophageal ulcerations (21); oral ulcers in dogs have also been reported (22).

The data from our studied cases (Table 1) indicate that most cases occurred in females, and that the mean age of the patients was 48.5 years. However, associated factors indicated that most of the cases occurred among diabetic patients, in addition to patients with leukemias, lymphomas and HIV-AIDS. Most of these conditions have been reported in the literature (4,16-19), and it is important to emphasize that they are the background diseases most frequently associated with oral candidiasis. With regard to the course of the disease, there is a subacute stage that lasts for about 8 days, also similar to cases of candidiasis. It is important to emphasize that the majority of cases were associated with diabetes mellitus, and this is probably due to the presence of higher serum glucose levels, which stimulate the growth of yeasts such as *Candida, Geotrichum* and *Trichosporon*. Recognition of this fact allows the use of prophylactic treatment, as is also the case for affected patients who are immunosuppressed (4,23,24).

From a mycologic standpoint, direct examination and staining may provide a rapid diagnosis of the infection, particularly when multiple hyphae with arthroconidia are evident, this being the most frequent diagnostic sign we encountered (66.6% of cases). However, some arthroconidia may have a rounded appearance and may be easily mistaken for *Candida*, since the latter may form pseudohyphae, hyphae and blastoconidia. Septate hyphae alone were seen is a smaller proportion of cases but, as mentioned above, the same feature may be observed in many cases of chronic candidiasis. These circumstances mean that culture alone can confirm the diagnosis. *G. candidum* and *G. capitatum* are easily identifiable, since they present as white, membranous, villous, wet colonies appearing as multiple rectangular arthroconidia under the microscope. The diagnosis can be easily confirmed with biochemical tests. Currently available chromogenic culture media (CHROMagar-Candida®) can allow easy identification. Their villous wet growth with slight pink pigmentation distinguishes them from the major *Candida* species. It is important to stress that *G. candidum* is inhibited by cycloheximide (actidione), and therefore culture media containing this antibiotic should never be used (1-4). Molecular biology is undoubtedly the most accurate technique for identifying both species by the internal transcriber spacer (rDNA); in order to identify *G. candidum*, the most useful sequence is the D1/D2 domain of the large subunit (26S), and for *G. capitatum*, the sequences of the ITS-1 and ITS-2 regions (16,25).

Recently Henrich et al. (25) have reported a case of disseminated geotrichosis due to *G. candidum* in a patient with relapsed leukemia following allogeneic stem cell transplantation, together with an extensive review of cases in the literature, the majority being associated with neutropenia, especially that in diverse types of leukemia. Therefore it is important to be aware that the normal flora of the skin and mouth can lead to contamination of catheters, this condition has been previously (4,17,20,22).

In the second part of the present study, it was evident that the number of isolates was significantly smaller among normal individuals than among those with associated conditions, the isolation rates being 48% and 78%, respectively. The isolates obtained showed that most cases corresponded to yeasts of *Candida* spp., with *C. albicans* predominant in both groups. These data reflect those from similar studies, and are indicative of the striking increase of infections attributable to non-albicans species in recent years. In our study they accounted for 38.4% and 39.1%, respectively, in the two groups, there being no difference in prevalence between them. The mixed growth obtained in some cases was noteworthy. Chromogenic culture media are useful, and currently allow more than one species to be identified. Pursuant to the purpose of our study, it was noteworthy that although *G. candidum* was isolated in both groups, one isolate (2.8%) was obtained in group 1 and 5 (6.33%) in group 2, the difference being more than two-fold. These results indicate that *G. candidum* may be
part of the normal flora or act as a contaminant, and that when it occurs as an infection, it is probably of the endogenous type, similar to the situation in *Candida* spp. infections. *Geotrichum* spp. isolates have been obtained from various parts of the body (3-6), and those from the oral flora account for as much as 30% of healthy individuals (26,27); compared with this figure, our isolation rates were lower (2.8% and 6.33%). A recent study by Gonçalves et al. (24) of colonization in diabetic patients (treated with insulin) found that *Geotrichum* spp. was isolated at a rate of 0.57%. Thus, although these fungal isolates show great variability, they are considered to be part of the oral and intestinal flora.

This report has provided a more accurate picture of cases of oral geotrichosis, including its clinical and mycological characteristics, which are very similar to those of oral candidiasis, making it likely to be under- or misdiagnosed.

**References**

23. Mlinarić-Missoni E, Kalenić S, Vazić-Babić V (2005) Species distribution and frequency of isolation of yeasts and dermatophytes from toe webs of


