

## Colonization of the oral cavity by candida species: risk factors in long-term geriatric care

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**Abstract:** The population of elderly people in hospitals for long-term geriatric care presents many risk factors for nosocomial infection by *Candida species*. The aim of this work was to reduce the risk of *C. albicans* nosocomial infections starting from colonization of the oral cavity. The population of concern was the patients in long-stay geriatrics units; a sample of 110 people was selected by drawing lots. The clinical and biological parameters of each patient included in the study were recorded. The oral cavity was colonized by *Candida spp* in 67% of cases. The distribution of the strains showed that *C. albicans* was the most frequently identified strain, followed by *C. glabrata*; of the 73 patients with at least one strain of *Candida spp.*, 47 had a clinically diagnosed candidiasis (64.4%). The wearing of dentures was not statistically linked with the development of oral candidiasis. Detecting which patients have been colonized, identifying the risk factors and applying preventive measures should reduce the probability of elderly people falling into the vicious circle of infection-malnutrition-immune-depression. (J. Oral Sci. 45, 51-55, 2003)

Key words: *Candida species*; oral colonization; risk factors; geriatric care.

### Introduction

A review of the international literature clearly shows the concern of biologists, hygienists and clinicians faced with the increasing proportion of nosocomial infections by *Candida species (spp.)* in all hospital sectors and all classes of age, and with the emergence of new, potentially pathogenic *Candida spp.* (1,2). The number of *Candida spp.* nosocomial infections increased in the 1980's. Of the pathogenic agents responsible for septicemia in large hospitals in the USA, *Candida spp.* showed the second highest significant increase ( $P < 0.0001$ ) (3). In Europe *Candida spp.* ranks third among the microorganisms responsible for nosocomial infections in intensive care units (4). The last decade has also been marked by the frequency, seriousness and nosocomial origin of fungal infections (5,6). The death rate for these *Candida spp.* infections varies from 13 to 90% depending on the associated risk factors (1,7).

The endogenous origin of deep-seated candidiasis is the digestive tract, the normal habitat of *C. albicans*, hence the attempts at digestive decontamination in patients presenting risk factors. This endogenous reservoir was found to be oral in 47% of patients suffering from candidemia as compared to 26% in a control population. Exogenous origins are more difficult to prove. It has been estimated that 15 to 54% of cases are due to transport on the hands of hospital staff (8,9) and the inanimate objects of the hospital environment may also be elements in the transmission chain

Since the risk of infection is increased by the lowering of the patients' defenses, various groups of patients with immune deficits have been studied for opportunist nosocomial infections involving *Candida spp* (4,9-11).

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However, the number of studies devoted to elderly patients is much smaller, despite the fact that nosocomial infections occur more often in this population, where *Candida spp.* is the most frequently identified micro-organism (12). The lowering of cell-mediated immunity associated with aging (13) is a factor of susceptibility to the development of candidosis and the ear, nose and throat area ranks second among the source sites of nosocomial infection, with the infection stemming mainly from oral mycosis in eight cases out of ten (12). Patients in long-term geriatric hospital care are particularly vulnerable and the prevention of nosocomial infections starting in the mouth is important not only in terms of morbidity but also from the point of view of discomfort, malnutrition and quality of life (12,14-16). Axel (17) considers that the oral mucosa mirrors the overall state of health.

Consequently, the objective of our study was, starting from the pathogenic potential connected with colonization of the oral cavity by *Candida spp.*, to make hospital staff aware of the problem and to train them in dental hygiene. The aim of this work was to reduce the risk of *C. albicans* nosocomial infections starting from colonization of the oral cavity in long-term geriatric care.

## Materials and Methods

The study performed was a hospital protocol for clinical research (file reference 96-33 L in the French PHRC system) funded by the regional clinical research directorate of the Toulouse University Hospital Centre (Direction Régionale de la Recherche Clinique du Centre Hospitalier et Universitaire de Toulouse). The protocol was implemented after approval by the establishment's ethics committee (Comité Consultatif de Protection des Personnes en Recherche Biologique), with the informed consent of the patient or his legal representative, and after authorization by the Director General of the Toulouse University Hospital Centre.

### Population studied

The population was 210 patients present in the 7 long-stay units of the Geriatrics Department of the La Grave Hospital, which forms part of the Toulouse University Hospital Centre.

### Inclusion criteria

A sample of 110 people was selected by drawing lots. The inclusion criteria were sufficient opening of the mouth and antifungal therapy for more than two months.

### Exclusion criteria

Patient's opposition to the activities necessary for an oral

examination, the taking of oral samples or the application of hygiene care; and antifungal therapy for less than two months.

The patients were recruited from 7 long-stay units: A (24), B (16), C (8), D (13), E (12), F (25), G (12).

### Data collection

The clinical and biological parameters of each patient included in the study were recorded. Data were collected by the doctors and supervisory nursing staff of the unit for the parameters concerning the overall state of health, dependence, and current treatment. The dentist carried out a clinical examination of all the patients, collecting all the data to define oral status and taking samples for mycological identification.

### The clinical indicators of oral status

**The state of the mucosa:** candidiasis, and xerostomia classified by increasing seriousness: saliva not plentiful, saliva absent, and mucosa covered with mucosities.

### The presence of teeth and the existence of caries.

### The presence of gingivitis and the level of hygiene (plaque, tartar).

The "global" level of dental hygiene, whether or not the patient had teeth and/or dentures, was divided into three levels: adequate - no visible plaque; inadequate - accumulation of plaque at the base of the teeth; very inadequate - large accumulation of plaque. Oral samples were taken from each patient on the morning before breakfast by scraping the oral mucosa with a curette. The sample was transferred to a swab and immediately sent on a transport medium to the mycology laboratory.

### Mycological identification

The analysis of samples included a direct examination, culture and isolation on CHROMagar® (CHROMagar, Paris, FRANCE), a filamentation test and identification on Api 20C Aux kit (Bio Mérieux Vitek, Lyon, FRANCE). For each strain identified, the number of colonies forming units (cfu) in culture was classified into one of three groups: group 1; > 50 cfu, group 2; between 10 and 50 cfu, group 3; < 10 cfu.

### Genome analysis

All of the *C. albicans* strains isolated were deep frozen at -80°C until they were analyzed. Molecular typing was performed using two techniques (18). The first technique was 1° pulsed field electrophoresis, CHEF technique, with the Genepath System apparatus, using the Sma I restriction

enzyme, and the second was 2° PCR/ RAPD using a random universal primer (data not shown).

### Statistical method

The statistical analysis was carried out in the Epidemiology Department of the Toulouse University Hospital Centre. Data were input through D.M.90 software and the analysis itself used the EPI-INFO tool. It was based on comparisons of frequency distributions by  $\chi^2$  tests or the Fischer test for theoretical numbers of patients that were lower than five.

## Results

### General state of health of the population studied

The 110 patients studied, representing 61% of the patients in long-term geriatric hospital care, had an average age of 85.8 years. Of the patients, 77.3% were women and 22.7% men. They had been hospitalized for more than a year in 80% of the cases.

The level of dependence for the elementary activities of daily life was 76.4% for eating and mobility and 86% for incontinence. Only 23.6% could feed themselves independently, 6.4% having a gastric probe, 23.6% could move from the bed to a chair without help, and 13.6% were continent.

The main clinical characteristics of the study population were mental troubles (87.3%), diabetes (10.0%), and presence of bed sores (12.7%). The most frequently used therapeutic medicines were psychoactive (52.7%), anti-hypertensive (44.5%) and antibiotic (29%) drugs given during the previous two months.

For dental hygiene care, 65.2% of the patients were totally dependent on the nursing staff.

### Oral status

The characteristics of the oral status of the 110 patients examined as a whole are given in Table 1. They concern colonization by *C. albicans*, the presence of mycosis, xerostomia, the presence of teeth and their state, the wearing of dentures, and the level of hygiene. The clinical mycosis diagnoses concerned a hyperplastic mycosis localized on the dorsal side of the tongue in over 95% of cases and in 5% of the cases the mycosis had spread over the whole oral cavity. Mycosis affected women more often than men (48.2% vs. 24.0%) and the difference remained significant after adjustment for age ( $P < 0.05$ ). The wearing of dentures seemed to be linked to a higher rate of mycosis: 55.6% with dentures as compared to 36.5% without dentures.

Dental hygiene was classified as “adequate” in 47 cases (42.7%), “inadequate” in 36 cases (32.7%) and “very

inadequate” in 27 cases (24.5%). A dry-mouth syndrome or xerostomia was noted in 30 patients (27.3%) and ordered by increasing seriousness: saliva not very plentiful in 20 cases, saliva absent in 7 cases, and mucosa covered in mucosities in 3 cases. The type of breathing was oral (mouth open position) in 17.3% of cases. Gingival pathologies were diagnosed in 73.0% of the cases.

As far as dentures were concerned, 23 patients (63.9%) wore full dentures, 12 patients (34.4%) had partial dentures and one used a full denture/partial denture association. Denture hygiene was considered adequate in 32.0% of the cases. Overall, of the 44 patients with no natural teeth, 24 (54.6%) did not have dentures and, of the 66 patients still possessing natural teeth, 16 (24.3%) also had dentures.

### Colonization by Candida species

We identified 95 strains of *C. albicans*, 61 patients (55.4%) being affected by a single strain and 16 patients (11.0%) by two strains of *C. albicans* or one strain of *C. albicans* and one of *C. glabrata*. The distribution of the strains (Table 2) showed that *C. albicans* was the most frequently identified strain, followed by *C. glabrata*.

For *C. albicans*, the colonies identified were noted according to their number (Table 3). Comparing the clinical data with the results of the mycological analyses shows that, of the 73 patients with at least one strain of *Candida spp.*, 47 had a clinically diagnosed candidiasis (64.4%). Conversely, all the patients suffering from mycosis had a positive mycological analysis.

Table 1 Patients' oral health status

<b>All patients (n = 110)</b>	
colonization by Candida species	67.3%
presence of oral mycosis	42.7%
adequate dental hygiene	42.7%
xerostomia	27.3%
absence of teeth	40.0%
neither teeth nor dentures	21.8%
<b>Patients having teeth (n = 66)</b>	
adequate state of teeth	4.5 %
presence of caries	85.0%
presence of gingivitis	72.7%
<b>Patients wearing dentures (n = 36)</b>	
adequate denture hygiene	32.0%

## Statistical analysis of results

The tests comparing the rates of occurrence showed associations among the various parameters characterizing the 110 patients in our sample. The  $\chi^2$  tests were carried out to establish the statistical significance of the results. The following are the statistically significant findings:

- 1: Wearing a denture was related to colonization of the mouth by *Candida spp.* ( $P = 0.002$ ).
- 2: The number of *Candida spp.* detected was related to the development of candidiasis ( $P = 0.0001$ ).
- 3: The status of dental hygiene was related to development of gingivitis ( $P = 0.02$ ).

On the other hand, five factors examined were not statistically related:

- 1: Wearing a denture was not related to the development of candidiasis ( $P = 0.058$ ).
- 2: Physical dependence of patients was not related to the development of candidiasis ( $P = 0.16$ ).
- 3: The status of denture hygiene was not related to the development of mycosis ( $P = 0.48$ ).
- 4: The status of dental hygiene was not related to the development of candidiasis ( $P = 1.00$ ).
- 5: Xerostomia was not related to the development of mycosis ( $P = 0.35$ ).

## Discussion

In the population of elderly people studied, a worsening of the overall state of health, poor oral status and the side effects of the main treatments used contributed, directly or indirectly, to the risk factors for *Candida spp.* colonization. In the group we studied, 67.3% of subjects had been colonized and 43.9% had oral mycosis. These percentages are consistent with the figures found by Samaranayake (19) and Banting (20).

Concerning the distribution of the species of *Candida* involved, the present study shows a high percentage of *C.*

Table 2 Distribution of *Candida* species identified

Candida species	
<i>C. albicans</i>	73.0 %
<i>C. glabrata</i>	24.0 %
<i>C. krusei</i>	1.0 %
<i>C. tropicalis</i>	1.0 %
<i>C. geotrichium</i>	1.0 %

Table 3 Number of subjects colonized and number of colonies in culture

<i>C. albicans</i>	Number of subjects colonized	59.2%*
	Number of colonies in culture	
	< 10 cfu	27.0%
	10 - 50 cfu	31.7 %
	> 50 cfu	41.3%
<i>C. glabrata</i>	Number of subjects colonized	18.2%*
	Number of colonies in culture	
	< 10 cfu	14.3%
	10 - 50 cfu	28.6%
	> 50 cfu	57.1%

\*11% of subjects were colonized by *C. albicans* and *C. glabrata*.

*glabrata*, which represents 24% of the *Candida spp.* isolated, whereas in the 1980's, Kuc (21) identified 1.4% of *C. glabrata*. The distribution of *Candida spp.* has thus shifted in favor of *C. glabrata* in the last ten years or so. Samaranayake (19) identified 56 to 84% of *C. albicans* in oral candidiasis and in candidemia recorded 63% of *C. albicans* and 13% of *C. glabrata* (1). In the oral mucosa, Hannula (22) identified 4 *C. albicans* for 1 *C. glabrata*.

In our group of elderly people, the oral examination also showed that 21.8% of subjects without teeth did not have dentures, 85% had caries, and 72% had gingivitis statistically correlated with very inadequate hygiene. These results are consistent with those obtained for various studies on the oral status of elderly people in institutions (16,23,24).

These results are also consistent with previous studies on high levels of oral mycosis in elderly people hospitalized in a long-term geriatric unit. The present study reports risk factors related to mycosis development. The findings reinforce the necessity for further investigations.

The set of detrimental factors as a whole highlights the necessity of checking colonization of the mouth in order to prevent a vicious circle of infection-malnutrition-immune depression being set up.

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