INVESTIGATION

Presence of Candida spp. and candidiasis in liver transplant patients*

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Abstract: BACKGROUND: Candidiasis is the most common opportunistic fungal infection of the oral cavity caused by fungi of the genus Candida and usually associated with immunosuppressed individuals.

OBJECTIVES: To evaluate the presence of oral candidiasis and identify the presence of Candida spp. in liver transplant recipients and assess the association between the presence of the fungus and sociodemographic variables, dietary habits and environmental exposure.

METHODS: A cross-sectional study was performed with 49 patients who had undergone liver transplants at Hospital São Vicente de Paula in Passo Fundo - RS. Patient information was collected to obtain sociodemographic data, eating habits and environmental exposure. Fungal infections were screened by oral clinical examination and the presence of Candida spp by the collection of oral samples with a sterile swab, seeded in Sabouraud Dextrose Agar, incubated at 25°C and observed at 48 hours. To identify Candida albicans, the germ tube test was performed.

RESULTS: In 49 patient samples, 39% had the yeast of the genus Candida isolated and, of these patients, 12% had candidiasis, 66% of atrophic type and 34% pseudomembranous. Eleven yeast species were (58%) Candida non-albicans and eight (42%) Candida albicans.

STUDY LIMITATIONS: The present study presents as a limitation the inclusion of patients in different stages of immunosuppression.

CONCLUSION: The high incidence of Candida non-albicans in the oral cavity of transplant patients with a long period of transplantation is warning to a more effective control of the health of these individuals, especially those with older age.

Keywords: Candida; Candidiasis, oral; Organ transplantation

INTRODUCTION

Scientific and technological advances in medicine are prolonging the life of individuals, allowing severely ill patients to live longer, increasing the population at risk, in other words, patients with immunosuppressant conditions, making them more vulnerable to fungal infections.1-3 This population includes people with the human immunodeficiency virus (HIV), solid organ recipients or blood cell transplant and we should also take into consideration the appearance of new more potent immunosuppressants, the use of invasive therapeutic technique in intensive care units, the wide use of broad-spectrum antibiotics and the more aggressive chemotherapy for malignancies (causing mucositis and neutropenia).4,5 The incidence and severity of such infections as well as the causative pathogenic agents could be related to many risk factors of the patient such as underlying diseases, immunosuppression state and, even, the individual’s geographical location.6,7 With the introduction of more effective prophylactic strategies and the refinement in the immunosuppression regimens, the number of infectious complications after organ transplantation has been decreasing, however, infections remain as one of the life-threatening complications.8

Candidiasis is the most common fungal infection of the oral cavity, caused by fungi of the genus Candida, particularly Candida albicans, even though other species could be involved. Usually, the oral...

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infection by Candida species is associated to immunocompromised individuals and it is characterized as an opportunistic infection.\(^7\)

Oral candidiasis is among the indicators of immunodeficiency and the last decades studies in many countries have shown a change in the epidemiology of Candida spp. infections, with an increased incidence of Candida non-albicans such as C. glabrata, C. tropicalis, C. parapsilosis and C. krusei. A concerning tendency is the significant increase of strains resistance to many antifungals of the azoles and echinocandin classes. Besides, two thirds of candidemia are seen outside intensive care units.\(^8,9\) This epidemiological change has a significant impact in the therapeutic options for the initial and definitive treatment of this condition.\(^10,11\) However, the little information available regarding opportunistic infections in patients outside intensive care units are relevant to guarantee the survival of these individuals.

In view of the panorama of the problem discussed, the objective of this study is to evaluate the presence of oral candidiasis and identify the fungi of the genus candida in liver recipients, as well as analyze the association between the presence of Candida spp. and sociodemographic, dietary habits and environmental exposure variables.

METHODS

Ethical aspects

The study was preceded by the approval of the committee of ethics in research (CEP) under the number 1.216.546, following the ethical aspects of the resolution 466/12 of the Conselho Nacional de Saúde.

Design, period and place of the study

This was a cross-sectional study performed from September to October 2015.

Population and sample

All patients (n = 49) who underwent a liver transplant, older than 18 years of age and who consented in participating of the study were included.

Collection of epidemiological data

The collection of data was conducted one single time under the supervision of the physician in charge. A standardized questionnaire was applied according to what was proposed by Sabadin et al.\(^12\), with data of sociodemographic variables (age, sex, state of residency, marital status, current professional activity, individual income, time from the transplant, reason for transplant); dietary habits and environmental exposure variables (lived in or traveled to areas with endemic mycosis or parasitic infections, exposure to pets, exposure to children younger than 10 years of age, water used to drink, habit of eating raw meat, non-pasteurized milk and milk products, seafood, and the presence of cutaneous abnormalities/conditions-infectious processes caused by fungi on the skin and/or nails).

Collection of data for microbiology

An oral clinical examination was performed to evaluate the presence of oral candidiasis and of fungi of the genus Candida. With the aid of sterile oral spacers, an oral sample was collected with sterile swab, seeded in petri dishes containing dextrose agar Sabouraud with added chloramphenicol, incubated at 25°C and examined in 24 and 48 hours. In patients who did not present lesions, samples were collected to investigate the presence of the yeast. The samples that showed the growth of creamy colonies in the culture and gram-positive yeast cells on direct microscopy were considered as positive results for yeasts of the genus Candida.

Variables and data analysis

The presence of Candida spp. was utilized as dependent variable, therefore including the patients who had candidiasis and those who had fungus of the genus Candida. For independent variables, data from the questionnaire applied to the patients were used.

All data were recorded and typed into a specific databank for the descriptive and inferential statistical analysis of this study. Data were electronically processed with the program Statistical Package for Social Science (SPSS), version 17.0. In the present study, we opted not to perform a multivariate analysis and to use a bivariate analysis with Pearson’s chi-square test ($\chi^2$). This is a test of hypotheses destined to find a value of the dispersion for two normal variables and to evaluate the existence association between qualitative variables. Therefore, the association between the dependent variable (presence of Candida spp.) And the independent variables were tested at a level of significance of 5% and a confidence interval of 95%, taking the unilateral hypothesis into consideration. The variables associated to the outcome were those that had a level of significance lower than 0.05.

RESULTS

Data descriptive analysis

Of the 49 individuals evaluated in this study, most were female (83.7%) with a mean age of 59 years, the majority married (87.8%) and living in the state of Rio Grande do Sul (83.3%). More than half of the participants (57.1%) were not practicing their occupation (inactive). Regarding the individual monthly income, 55.1% received up to R$ 2,000.00. The larger proportion of liver recipients underwent transplantation less than 10 years back (63.3%), according to table 1.

Hepatitis C was the main condition that led to transplant, having affected 20 (41%) patients in the sample, followed by hepatitis B (29%), alcoholism (14%), cancer (6%) or other causes (10%).

Regarding the variables related to environmental exposure, 38% reported living in or having traveled to areas outside their state of residency. Regarding dietary habits, 71% reported eating at least one of the following foods: raw meat, non-pasteurized milk and milk products and seafood. In addition, 27% drank mineral water and 41% reported cutaneous changes after the transplant (Table 2).

Of the 49 patients evaluated, the presence of Candida spp. was seen in 19 (39%) and of those, six (12%) had oral candidiasis, four (66%) of the atrophic type and two (33%) of the pseudomembranous type (Figures 1 and 2).

Of the 19 (39%) samples of Candida, eight (42%) were C. albicans, confirmed by the formation of the germ tube and 11 (58%) Candida non-albicans.
**Table 1: Total distribution of liver recipients according to sociodemographic variables**

| Sociodemographic variables | n (49) | % (100) |
|----------------------------|--------|---------|
| **Sex**                    |        |         |
| Male                       | 8      | 16.3    |
| Female                     | 41     | 83.7    |
| **Age group**              |        |         |
| 21 to 59 years             | 24     | 49.0    |
| 60 to 78 years             | 25     | 51.0    |
| **Marital status**         |        |         |
| Married                    | 43     | 87.8    |
| Single, widowed, divorced  | 6      | 12.2    |
| **State**                  |        |         |
| Rio Grande do Sul          | 40     | 83.3    |
| Santa Catarina              | 9      | 16.7    |
| **Current professional activity** |  |  |
| Active                     | 21     | 42.9    |
| Inactive                   | 28     | 57.1    |
| **Individual monthly income** |  |  |
| Up to R$ 1,000.00          | 13     | 26.5    |
| From R$ 1,000.00 to R$ 2,000.00 | 14  | 28.6    |
| Above R$ 2,000.00          | 22     | 44.9    |
| **Date of the transplant** |        |         |
| 1 to 9 years               | 31     | 63.3    |
| 10 to 15 years             | 18     | 36.7    |

**Table 2: Distribution of the liver recipients regarding exposure to environmental factors and dietary habits**

| Variables                                                                 | n (49) | % (100) |
|---------------------------------------------------------------------------|--------|---------|
| Lives in or traveled to areas with endemic mycosis or parasitic diseases |        |         |
| Yes                                                                       | 11     | 22      |
| No                                                                        | 38     | 78      |
| Exposure to pets                                                          |        |         |
| Yes                                                                       | 34     | 70      |
| No                                                                        | 15     | 30      |
| Water used to drink                                                       |        |         |
| Mineral                                                                   | 27     | 55      |
| Tap                                                                       | 22     | 45      |
| Exposure to young children                                                |        |         |
| Yes                                                                       | 8      | 16      |
| No                                                                        | 41     | 84      |
| Eating habits: raw meat, non-pasteurized milk and milk products and seafood |        |         |
| Yes                                                                       | 35     | 71      |
| No                                                                        | 14     | 29      |
| Cutaneous changes                                                        |        |         |
| Yes                                                                       | 20     | 41      |
| No                                                                        | 29     | 59      |

**Data inferential analysis**

After the statistical analysis, it was possible to observe that regarding the sociodemographic characteristics, the variable time from transplant was associated to the dependent variable of presence of *Candida* spp. This result shows an increased presence of *Candida* spp. in patients with a longer time from transplant (*p* = 0.016). Regarding the variable age group, there were no relationships between the variables, however, the values were borderline with *p* = 0.05. The results are shown in table 3.

**DISCUSSION**

Solid organ transplant recipients are under the risk of fungal infections, many times due to the prolonged use of immunosuppressive drugs. The knowledge of the fungal species, the early diagnosis and the adequate treatment of these infections are key to improve the survival and reduce the mortality of transplant patients. In this study we demonstrated a prevalence of presence of *Candida* spp. of 39%. Levesque et al. investigated 52 liver transplant patients in the hospital in France and found yeasts of the genus *Candida* in 81% of the individuals, *C. glabrata* being the most prevalent species (47%). The same study demonstrated that during the period of observation, six cases of invasive candidiasis occurred in these patients. A research conducted by Rai et al. demonstrated 29 posi-
### Table 3: Inferential analysis between the dependent variable presence of *Candida* spp. and independent variables

| VARIABLES                              | Presence of Candida spp. |   |   |   | p  |
|----------------------------------------|--------------------------|---|---|---|----|
|                                        | Yes (n (%) | No (n (%)) | TOTAL (n (%)) |   |
| Age group                              |             |             |               | 0.050 |
| 21 to 59 years                         | 6 (31.6)    | 18 (60)     | 24 (49)       |    |
| 60 to 78 years                         | 13 (68.4)   | 12 (40)     | 25 (51)       |    |
| Sex                                    |             |             |               | 0.370 |
| Female                                 | 4 (21.1)    | 4 (13.1)    | 8 (16.3)      |    |
| Male                                   | 15 (78.9)   | 26 (86.7)   | 41 (83.7)     |    |
| Marital status                         |             |             |               | 0.147 |
| Married                                | 15 (78.9)   | 28 (93.3)   | 43 (87.8)     |    |
| Divorced, widowed or single            | 4 (21.1)    | 2 (6.7)     | 6 (12.2)      |    |
| State of residency                     |             |             |               | 0.489 |
| Rio Grande do Sul                      | 15 (78.9)   | 25 (83.3)   | 40 (81.6)     |    |
| Santa Catarina                         | 4 (21.1)    | 5 (16.7)    | 9 (18.4)      |    |
| Occupation/job                         |             |             |               | 0.165 |
| Active                                 | 15 (50)     | 6 (31.6)    | 21 (42.9)     |    |
| Inactive                               | 13 (68.4)   | 15 (50)     | 28 (57.1)     |    |
| Individual income                      |             |             |               | 0.952 |
| Up to R$ 1,000.00                      | 5 (26.3)    | 8 (26.7)    | 13 (26.5)     |    |
| From R$ 1,000.00 to 2,000.00           | 5 (26.3)    | 9 (30)      | 14 (28.6)     |    |
| Above R$ 2,000.00                      | 9 (47.4)    | 13 (43.3)   | 22 (44.9)     |    |
| Time of transplant                     |             |             |               | *0.016 |
| 1 to 9 years                           | 8 (42.1)    | 23 (76.7)   | 31 (63.3)     |    |
| 10 to 15 years                         | 11 (57.9)   | 7 (23.3)    | 11 (36.7)     |    |
| Complications post-transplant          |             |             |               | 0.228 |
| No                                     | 6 (31.6)    | 14 (46.7)   | 20 (40.8)     |    |
| Yes                                    | 13 (68.4)   | 16 (53.3)   | 29 (59.2)     |    |
| Lives in or traveled to areas with endemic mycosis or parasitic diseases | | | | 0.571 |
| No                                     | 15 (78.9)   | 23 (76.7)   | 38 (77.6)     |    |
| Yes                                    | 4 (21.1)    | 7 (23.3)    | 11 (22.4)     |    |
| Exposure to pets                       |             |             |               | 0.329 |
| No                                     | 7 (36.8)    | 8 (26.7)    | 15 (30.6)     |    |
| Yes                                    | 12 (63.2)   | 22 (73.3)   | 34 (69.4)     |    |
| Water used to drink                    |             |             |               | 0.506 |
| Mineral                                | 10 (52.6)   | 17 (56.7)   | 27 (55.1)     |    |
| Tap                                    | 9 (47.4)    | 13 (43.3)   | 22 (44.9)     |    |
| Exposure to young children             |             |             |               | 0.134 |
| No                                     | 14 (73.7)   | 27 (90)     | 41 (83.7)     |    |
| Yes                                    | 5 (26.3)    | 3 (10)      | 8 (16.3)      |    |
| Eating habits: raw meat, non-pasteurized milk and milk products and seafood | | | | 0.276 |
| No                                     | 4 (21.1)    | 10 (33.3)   | 14 (28.6)     |    |
| Yes                                    | 15 (78.9)   | 20 (66.7)   | 35 (71.4)     |    |

*p < 0.005 = statistically significant difference.*
tive samples for the presence of Candida, Aspergillus or Alternaria as agents of secondary infections out of a total of 45 samples collected from sick patients. Solid organ transplant recipients are susceptible to opportunistic infections, therefore the correct diagnosis and the knowledge on the epidemiology of the main infectious fungus becomes important.26

Despite the lack of sufficient evidences to prove that liver transplant recipients have a higher prevalence of Candida spp. in the oral cavity compared to immunocompetent individuals, we can call attention for the need of specialized care with the oral cavity of these patients in order to avoid complications such as systemic infections caused by opportunistic microorganisms due to the use of immuno-suppressive therapy after the transplant.

Infections by Candida species correspond to the larger part of invasive mycosis in the group of transplant patients.12 In this study we observed six (12%) cases of oral candidiasis, four (66%) of the atrophic type and two (33%) of the pseudomembranous type. A similar study was performed by Rojas et al.,17 in which they reported a rate of 7.5% of clinical candidiasis in liver transplant recipients. In a study conducted by Gondim et al.,18 the prevalence of candidiasis ranged from 3.7% to 18.7%, with the erythematous (atrophic) type being the most frequent. Rezvani et al.,19 observed oral candidiasis of the erythematous type in 8.5% of the patients studied (immunosuppressed transplant recipients) and also found a percentage of 17.1% of episodes of candidiasis, with 76% of the pseudomembranous type. In another study with kidney transplant patients, 15.8% had oral candidiasis.20

These facts demonstrate that immunosuppressed patients are more vulnerable for the development of candidiasis because, despite the occurrence of infectious episodes between many studies being variable, they are more frequent in solid organ recipients.

Even though multiple studies demonstrate C. albicans as the main species isolated from patients with invasive candidiasis, we can observe a significant increase in Candida non-albicans species, particularly C. tropicalis and C. parapsilosis, and that tendency has already been noted in any situations of candidemia.21 In this study, eight species of C. albicans and 12 of Candida non-albicans were identified. A study performed by Levesque et al.,22 reported 42 cultures (81%) of Candida spp., with the prevalent species being C. glabrata (47%), what demonstrates the importance of the identification of the fungal species, since Candida non-albicans species can present with a reduced sensitivity to certain conventional antifungals. In contrast to this study, the investigation conducted by Mimica et al.,23 characterized 50% of the samples as C. albicans; 20.8%, C. tropicalis; 2.4%, C. krusei and 26.9%, other species (undetermined). Crocco et al.,24 identified with the CHROMagar Candida technique, C. albicans in 76% of the studied samples, C. krusei in 19%, followed by C. tropicalis in 1%. Also, in Rocha et al.,25 research, C. albicans was the most prevalent species (86.4%), followed by C. tropicalis (4.5%). In the study by Wingeter et al.,26, 93% de C. albicans were identified in the samples. These studies highlight the importance of the identification of the fungal agent in order to indicate the adequate treatment as early as possible, avoiding the risk of invasive fungal infections.26

Oral candidiasis can be considered a problem that aggravates the health of individuals with an abnormality of the immune system due to the use of immunosuppressants.27 In this study, the presence of the disease was compared to variables subjected to possible risk factors. After statistical analysis, we found that the time of the transplant was associated to the dependent variable of presence of candidiasis. In a similar study, Couto et al.,27 observed that the fungal infection in patients submitted to liver transplant is dependent on some factors that can interact favoring the appearance of the disease, such as intensity of exposure to potential pathogens, degree of immunosuppression used and post-operative care. Sun et al.,28 observed that age and frequency of daily brushing of the teeth were risk factors for colonization by Candida spp., even though there was no significant relationship with the patient’s age in this study, but the values were close to significant. Regardless of the type of transplant and immunosuppressant drugs, studies highlight attention with possible risk factors, because these require different strategies for the prevention and control of Candida spp. infection.

As limitations of this study, we can report the small sample seen at the ambulatory of the hospital in the period of the study, the inclusion of patients in different stages of immunosuppression as well as the absence of a healthy control group, which hindered a design that allowed comparing between groups. This way, it would have been possible to reach more definitive conclusions when comparing the results to those of other studies.

It is important to note the results of the study on the subject can be explained by different designs, diversity in sample sizes and indicators of evaluation, besides other factors that can also be involved.

Even though the sample size is small, the results highlight the need for a more effective control of the health of these patients, particularly those with more advanced age. Besides, there was a higher incidence of the presence of Candida spp. in patients with longer time of transplant, increasing the morbidity risk in this population.

CONCLUSION

Candida species classified as non-albicans have been emerging in all fungal infections. This scenario is concerning, since the antifungal armamentarium available is very restricted and, in some cases, ineffective in infections caused by multiresistant strains. The infection reaches this severity when the correct diagnosis is not made due to the lack of laboratory standardization for the identification of fungi.

We demonstrate in the group studied that the oral cavity of liver transplant patients is being inhabited, in most part, by Candida non-albicans, what can be an alert for a more effective control of the health of these patients, particularly in those with more advanced age.\[\]
REFERENCES

1. Wingard JR. Importance of Candida species other than C. albicans as pathogens in oncology patients. Clin Infect Dis. 1995;20:115-25.
2. Vuudes A, Pernan J, Cantón E, Ubeda P, López-Ribot JL, Gobernado M. Candidemia at a tertiary-care hospital: epidemiology, treatment outcome and risk factors for death. Eur J Microbiol Infect Dis. 2002;21:767-74.
3. Binder U, Lass-Röll C. Epidemiology of invasive fungal infections in the Mediterranean area. Medit J Hematol Infect Dis. 2011;3:e20110016.
4. Pfaffer MA, Andes D, Diekema DJ, Espinel-Ingroff A, Sheehan D; CLSI Subcommittee for Antifungal Susceptibility Testing. Wild-type MIC distributions, epidemiological cutoff values and species-specific clinical breakpoints for fluconazole and Candida: Time for harmonization of CLSI and EUCAST broth microdilution methods. Drug Resist Updat. 2010;13:80-95.
5. Warnock DW. Trends in the epidemiology of invasive fungal infections. Nihon Ishinkin Gakai Zasshi. 2007;48:1-12.
6. Nery LE, Fernandes ALG, Perfeito JA. Guia de Pneumologia. Barueri: Manuele; 2006. p. 129-38.
7. Cruz MCFN, Garcia JGF, Braga VAP, Lopes FF, Pereira ALA. Lesões brancas da cavidade oral - uma abordagem estomatológica. Rev Fac. Odontol. 2009;50: 5-8.
8. Hajjeh RA, Sofair AN, Harrison LH, Lyon GM, Arthington-Skaggs BA, Mirza SA, et al. Incidence of bloodstream infections due to Candida species and in vitro susceptibilities of isolates collected from 1998 to 2000 in a population-based active surveillance program. J Clin Microbiol. 2004;42:1519-27.
9. Almirante B, Rodriguez D, Park BJ, Cuenca-Estrella M, Planes AM, Almeida M, et al. Barcelona Candidemia Project Study Group. Epidemiology and predictors of mortality in cases of Candida bloodstream infection: results from population-based surveillance, Barcelona, Spain, from 2002 to 2003. J Clin Microbiol. 2005;43:1829-35.
10. Kaur R, Dhakad MS, Goyal R, Kumar R. Emergence of non-albicans Candida species and antifungal resistance in intensive care unit patients. Asian Pac J Trop Biomed. 2016;6:455-60.
11. Morschhäuser J. The development of fluconazole resistance in Candida albicans - an example of microevolution of a fungal pathogen. Review Biology Of Human Fungal Pathogen. J Microbiol. 2016;54:192-201.
12. Mushli MF, MERMISCI CI, Bader O, Bi C, MIRAMBO MM, GOFF U, et al. High oral carriage of non-albicans Candida among HIV-infected individual. Int J Infect Dis. 2016;49:185-8.
13. Sabadín CS, Benvegnu SA, da Fontoura MM, Saggin LM, Tomimori J, Fischman O. Onychomycosis and tinea pedis in athletes from the state of Rio Grande do Sul (Brazil): A cross-sectional study. Mycopathologia. 2011;171:183-9.
14. Levesque E, El Ambass S, Sitterte E, Foutet F, Merle JC, Botterel F. Contribution of (1,3)-beta-D-glucan to diagnosis of invasive candidiasis after liver transplantation. J Clin Microbiol. 2015;53:771-6.
15. Rai S, Tripathi P, Saraf A. Isolation and characterization of opportunistic fungi causing secondary infection in debilitated patients. Recent Res Sci Technol. 2013;3:32-5.
16. Anesi JA, Baddley JW. Approach to the solid organ transplant patient with suspected fungal infection. Infect Dis Clin North Am. 2016;30:277-96.
17. Rojas G, Bravo L, Cordero K, Sepulveda L, Elgueta L, Diaz JC, et al. Centralization of the oral tissues in patients with solid-organ transplants. J Transplant. 2012;2012:603769.
18. Gondim LAM, Araújo CRF, Ferreira MAF, Medeiros AMC, Maciel SSV, Tabosa FL. Manifestações estomatológicas em receptores de transplante renal: uma revisão sistemática. Revista da AMRIGS. 2009;53:16-21.
19. Rezvani G, Davarmanesh M, Azar MR, Salehipour M, Sedaghat R, Karimi F, et al. Oral manifestations of allograft recipients before and after renal transplantation. Saudi J Kidney Dis Transpl. 2014;25:279-84.
20. De la Rosa-García E, Mondragón-Padilla A. Lesiones bucales asociadas a inmunosupresión en pacientes con trasplante renal. Rev Med Inst Mex Seguro Soc. 2014;52:442-7.
21. De Luca M, Green M, Symmonds J, Klieger SB, Sohtys K, Fisher BT. Invasive candidiasis in liver transplant patients: Incidence and risk factors in a pediatric cohort. Pediatr Transplant. 2016;20:235-40.
22. Mimica LMAI, Ueda SM, Martino MDV, Navarino A, Martinui U. Diagnóstico de infecção por Candida: avaliação de testes de identificação de espécies e caracterização do perfil de susceptibilidade. J Bras Patol Med Lab. 2009;45:17-23.
23. Crocco EI, Mimica LMAI, Muramatu LH, Garcia C, Souza VM, Ruz RB, et al. Identification of Candida species and antifungal susceptibility in vitro: a study on 100 patients with superficial candidiasis. An Bras Dermatol. 2004;79:699-701.
24. da Silva-Rocha WP, Lemos VL, Sévizski TI, Milan EP, Chaves GM. Candida species distribution, genotyping and virulence factors of Candida albicans isolated from the oral cavity of kidney transplant recipients of two geographic regions of Brazil. BMC Oral Health. 2014;14:20.
25. Wingeter MA, Guillermetti E, Shinobu CS, Takaki I, Sévizski TI. Microbiological identification and in vitro sensitivity of Candida isolates from the oral cavity of HIV-positive individuals. Rev Soc Bras Med Trop. 2007;40:272-8.
26. Aw D, Silva AB, Palmer DB. Immunosenescence: emerging challenges for an ageing population. Immunology. 2007;120:435-46.
27. Couto WJ, Branco JNR, Almeida D, Carvalho AC, Vicks R, Teles CA, et al. Transplante cardíaco e infecção. Rev Bras Cir Cardiovasc. 2001;16:141-51.
28. Sun H, Chen Y, Zou X, Li H, Yin X, Qin H, et al. Occurrence of Candida spp. and candidiasis in liver transplant patent. An Bras Dermatol. 2018;93(3):356-61.

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