ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 10, pp.74622-74627, October, 2018

DOI: https://doi.org/10.24941/ijcr.32516.10.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

EVALUATION OF CANDIDA ISOLATES FROM THE SALIVA SAMPLES OF HIV SEROPOSITIVE PATIENT

***Swapna Patankar**

Department of Oral and Maxillofacial Pathology, BVDU Dental College and Hospital, Pune, India

ARTICLE INFO

Article History:
Received 16th July, 2018
Received in revised form
07th August, 2018
Accepted 29th September, 2018
Published online 31st October, 2018

Key Words:
Candida,
HIV seropositive.

ABSTRACT

Aim: To assess the presence of candida isolates from saliva samples of HIV sero-positive patients.
Objectives: To study the expression of different species of candida isolates from saliva samples of HIV sero-positive patients and to identify if any newer species candida is present in the saliva samples of HIV sero-positive patients.
Materials and Method: 30 subjects with recently detected HIV sero-positive status and not undergoing Anti-Retroviral Therapy were selected. 0.5 ml of saliva samples were collected in the sterile bottles from these patients. These samples were sent to the laboratory within 2 hours of collection for further microbiological study. Germ tube test, morphology on Cornmeal Agar, Sugar Fermentation tests and Sugar Assimilation tests were used for identification of isolates and their species. Rapid identification for yeast fungi was also done by means of Autoscan 4 rapid yeast identification panel.
Results: Of 30 patients analyzed, 16 (53%) were C. albicans, 5 (31%) were C. tropicalis, 2 (13%) C. lusitaniae, C. guillermondii and Tricosporon beigelii, 1(6%) C. glabrata, C. krusei, Rhodotorula rubra and Zygomycetes mucor species. It is evident from our study that Candida albicans and Non- albicans species of Candida are commensal organisms of the oral cavity. They tend to become pathogenic in immunocompromised HIV-sero-positive patients. They are responsible for Oropharyngeal Candidiasis in these individuals. These organisms show a change in susceptibility pattern to various anti-fungal drugs available. So it is necessary to know the causative Candida Isolate so that an appropriate treatment for Oropharyngeal Candidiasis in HIV-sero-positive patients can be given.

Citation: ***Swapna Patankar*, 2018.** "Evaluation of Candida Isolates from the Saliva Samples of HIV Seropositive Patient", *International Journal of Current Research*, 10, (10), 74622-74627.

INTRODUCTION

The human immunodeficiency virus (HIV) is a lentivirusthat causes the Acquired Immunodeficiency Syndrome (AIDS), a condition in humans in which progressive failure of the immune system allows life-threatening opportunistic infections and cancers to thrive. HIV infects vital cells in the human immune system such as helper T cells (specifically CD4+ T cells), macrophages and dendritic cells. HIV infection leads to low levels of CD4+ T cells through a number of mechanisms including: apoptosis of uninfected bystander cells, direct viral killing of infected cells and killing of infected CD4+ T cells. When CD4+ T cell numbers decline below a critical level, cell-mediated immunity is lost and the body becomes progressively more susceptible to opportunistic infections (Jonathan Weber, 2013). Oropharyngeal candidiasis (OPC) is the most frequent opportunistic fungal infection among human immunodeficiency virus (HIV)-infected patients (Sharon Walmsley *et al.,* 2001). OPC is frequently complicated by esophageal candidiasis, which may limit food consumption and lead to weight loss, threatening the general health and well-being of HIV-infected patients. Furthermore, clinical and in vitro resistance to antifungal azoles frequently occurs in OPC when CD4 cell counts fall to 200 cells/ cubic mm of blood, either by selection or acquisition of resistant strains of *Candida albicans*or by infection with inherently resistant species of *Candida* other than *C. Albicans* (Jeannette Guarner and Mary Brandt, 2011; Rachana Prabhu, 2013; Sardi Scorzoni *et al.,* 2013). Oral burdens of *C. albicans* are augmented in HIV-infected patients even prior to the first episode of OPC and the intensity of carriage increases significantly in the progression from asymptomatic *Candida* carrier to an episode of OPC. These observations indicate that normal defenses against *Candida* are perturbed early in the progression of HIV infection before any marked depletion of CD4 cells has occurred (Prasanna Kumar Rao, 2012). C. albicans and other species of Candida are found in 40% of healthy humans. However, colonization often leads to opportunistic mucosal or life-threatening deep organ infection in immune-compromised hosts. The majority of patients (77 to 100%) with OPC are infected with *C. albicans*, while the remaining patients are infected with one or more non- *albicans* species of *Candida*,

Corresponding author:* **Swapna Patankar,
Department of Oral and Maxillofacial Pathology, BVDU Dental College and Hospital, Pune, India.

either alone or in combination with *C. albicans*. A diversity of non-*albicans* species of *Candida* are found, including *Candidatropicalis*, *Candida parapsilosis*, *Candida guillermondii*, *Candidaglabrata*, and *Candida dubliniensis*. However, among these species only *C. dubliniensis* has been specifically associated with and recognized as the sole cause of OPC in HIV infection (Krcmery and Barnes, 2002; Aarti Mane *et al.,* 2010; Akpan, and Morgan, 2014). The diagnosis of candidiasis is based on clinical signs and symptoms, laboratory testing, and the response to antifungal treatment. Laboratory tests include smears from the lesions using Gram's stain or a potassium hydroxide preparation or cultures from the skin, mouth, vagina, urine, sputum, or stool (Aarti Mane *et al.,* 2010). A culture is obtained if identification of the species or strain is desired. Studies have shown that high colony counts of Candida species in saliva collections correlate with the presence of clinical infection, and quantitative counts may be used in diagnosis (Cyril Enwonwu and Valli Meekst, 1996; Usha Arora *et al.,* 2003; Jair Leao and Camila Riberio, 2009). With the emergence of other species of Candida as pathogens and a development of change in the susceptibility pattern of the C. albicans, as well as the newer species of Candida, it is necessitating the isolation and identification of the causative species. The present study is undertaken to identify the Candida Isolates in saliva samples of HIV sero-positive patients (Deborah Greenspan and John Greenspan, 1996).

MATERIALS AND METHODS

30 subjects with recently detected HIV sero-positive status and not undergoing Anti-Retroviral Therapy were selected. 0.5 ml of saliva samples were collected in the sterile bottles from these patients. These samples were sent to the laboratory within 2 hours of collection for further microbiological study. Germ tube test, morphology on Cornmeal Agar, Sugar Fermentation tests and Sugar Assimilation tests were used for identification of isolates and their species. Rapid identification for yeast fungi was also done by means of Autoscan 4 rapid yeast identification panel.

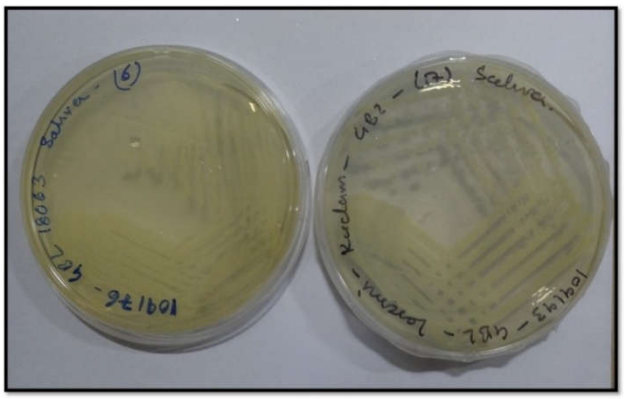
RESULTS

Thirty patients diagnosed with HIV and not receiving ART were enrolled in this longitudinal study. Out of thirty patients, 3 were male patients and 27 were female patients. The average age was 36.3 years. Of 30 patients analyzed, 16 (53%) were C. *albicans*, 5 (31%) were C. *tropicalis*, 2 (13%) C. *lusitaniae*, C. guillermondii and Tricosporonbeigelii, 1(6%) C. *glabrata*, C. krusei, Rhodotorularubra and Zygomycetesmucor species.

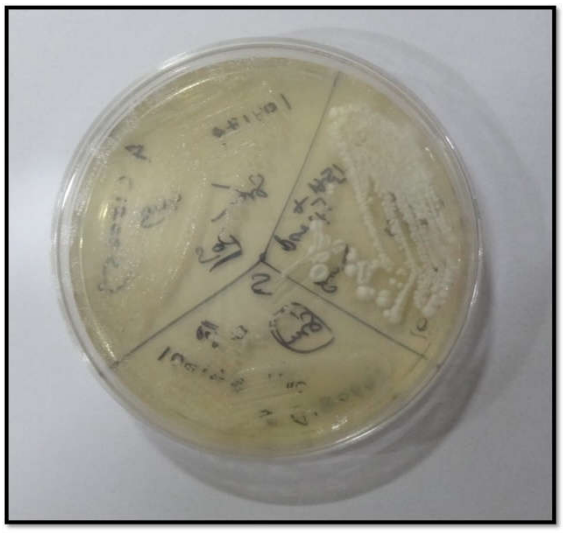
DISCUSSION

In recent years, incidence of mycotic infections has increased due to increase in number of patient with immunosuppressive viral infections (Changdeo Aher, 2014). Among these infections Candidiasis is most common in this group of patients. Oropharyngeal candidiasis (OPC) is a common feature associated with HIV infection (Deorukhkar *et al.,* 2014). Oropharyngeal candidiasis occurs in approximately up to 90% of HIV infected cases during the course of infection.[65] It is also considered as an important marker of HIV and its progression (Aarti Mane *et al.,* 2010). Oropharyngeal candidiasis increases morbidity and also negatively affects the quality of life of HIV infected patients.

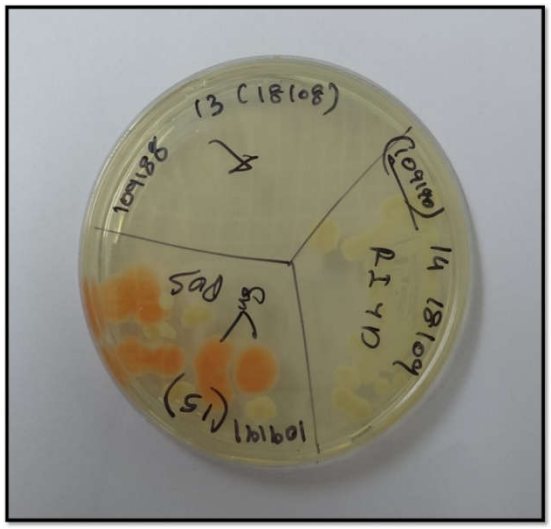
Several Candida species are known to colonize the human oropharyngeal tract, with Candida albicans colonization occurring most frequently.



Cream coloured colonies of Candida Isolates on Sabouraud dextrose agar



Cream coloured colonies of Candida Isolates (C. tropicalis) on Sabouraud dextrose agar



Rodotorula rubra – reddish orange colonies
Trichosporon beigelii – cream coloured colonies

Zygomycetes / Mucor species

Candida Krusei

These yeasts are usually commensals but may act as opportunistic pathogens. Colonization does not always lead to infection; however, it is a prelude to infection when host immunity is compromised and the risk of a disseminated infection is high (Foluso Owotade *et al.,* 2013). Sardi *et al.* in 2013, concluded that the virulence of Candida species is attributed to certain factors like adherence, biofilm formation, and the production of tissue damaging extracellular hydrolytic enzymes. The biofilm formation plays an important role in pathogenesis. Recent evidence suggests that majority of disease produced by C. *albicans* is associated with biofilm growth. Deorukhkar *et al.* in 2014, studied that the extracellular hydrolytic enzymes like phospholipase and proteinase are important for colonization and invasion of host tissue (Sachin *et al.,* 2014). Although *Candida albicans* is considered to be most prevalent cause of mucosal and systemic infections, in recent years incidence of infections due to Non-albicans Candida species like C. *glabrata*, C. *tropicalis* and C. *kruseihas* increased (Deorukhkar and Saini, 2014). Infection due to Non-albicans Candida species is clinically indistinguishable from that caused by C.*albicans*, but are more resistant to routinely used antifungal drugs (Changdeo Aher, 2014). Therefore, prompt identification of infecting species along with in vitro antifungal susceptibility testing is very important for prevention of emergence and spread of drug resistant Candida species (Deorukhkar and Saini, 2014).

According to, Changdeo Aherin 2014, C. glabratais often the second or third most common cause of candidiasis after C. *albicans*. C. *glabrata* infections can be mucosal or systemic and are common in abnormal hosts (e.g., immunocompromised persons or those with diabetes mellitus). C. glabrata infections are difficult to treat and are often resistant to many azole antifungal agents, especially fluconazole. Consequently, C. *glabrata* infections have a high mortality rate in compromised, at-risk hospitalized patients. C glabrata and C. tropicalis were the major isolates from NAC spp. The factorslike the widespread use of immunosuppressive drugs and the emergence of HIV/AIDS have favored the increase of C. glabrata infections. Oropharyngeal Candidiasis due to C. glabrata, tends to be more severe and more difficult to treat. C.tropicalis was the second most common isolate from Non-albicans Candida species (Changdeo Aher, 2014). *Rhodotorula* species have emerged as opportunistic pathogens that have the ability to colonise and infect susceptible patients. *Rhodotorula* species are ubiquitous saprophytic yeasts that can be recovered from many environmental sources. Most of the cases of infection due to *Rhodotorula* in humans were fungemia associated with central venous catheter (CVC) use and associated with diseases like haematologic malignancies in patients who were receiving corticosteroids and cytotoxic drugs. Also seen in patients taking broad-spectrum antibiotics and immunosuppression.

Unlike fungemia, some of the other localised infections caused by *Rhodotorula*, including meningeal, skin, ocular, peritoneal, and prosthetic joint infections (Fernanda Wirth and Luciano Goldani, 2012). Thus, from the results of our study, it is evident that Candida albicans and Non- albicans species of Candida are commensal organisms of the oral cavity. They tend to become pathogenic in immunocompromised HIV-sero-positive patients. They are responsible for Oropharyngeal Candidiasis in these individuals. These organisms show a change in susceptibility pattern to various anti-fungal drugs available. So it is necessary to know the causative Candida Isolate so that an appropriate treatment for Oropharyngeal Candidiasis in HIV-sero-positive patients can be given. This present study is an eye-opener for the importance of evaluation of Candida Isolates in saliva samples of HIV- sero-positive patients as, the yeast species not found in oral cavity are also seen to become opportunistic pathogens invading the oral cavity of these immunocompromised patients.

REFERENCES

AAkpan, R Morgan, 2002. “Oral candidiasis”; *Postgrad Med. J.,* 78:455–459.

Aarti Mane *et al*., 2010. “Species distribution and antifungal susceptibility of oral Candida colonizing or infecting HIV infected individuals”; *Indian J. Med. Res.*, 131, 836-838.

Ahmed S. Ali Musrati. 2013. “Oral Immune Defense Against Chronic Hyperplastic Candidosis”; Department of Oral Pathology and Medicine, Institute of Dentistry, University Of Helsinki, Helsinki, Finland.

Akpan, A., Morgan, R. 2014. “Oral candidiasis”; *Postgrad Med J.,* 78:455–459.

Andrei Barasch, Monika M. Safford, Frank A. Catalanotto, 2000. “Oral soft tissue manifestations in HIV-positive vs. HIVnegative children from an inner city population: A two-year observational study”; *Pediatr Dent.,* 22:215-220.

Anitha Krishnan, P. 2012. “Fungal Infections of the Oral Mucosa”; *Indian Journal of Dental Research,* 23(5), 2012.

Arnaldo, L. Colombo, 2011. Ana Carolina B. Padovan, AndGuilherme M. Chaves: "Current Knowledge Of Trichosporon Spp. And Trichosporonosis"; *Clinical Microbiology Reviews,* P. 682–700.

Arvind Shetti, Ishita Gupta, and Shivyogi M. Charantimath, 2011. "Oral Candidiasis: Aiding in the Diagnosis of HIV—A Case Report"; Hindawi Publishing Corporation Case Reports in Dentistry, Volume 2011, Article ID 929616, 4 pagesdoi:10.1155/2011/929616.

Back-Brito, G.N., Mota, A.J., Vasconcellos, T.C., Querido, S.M., Jorge, A.O. 2009. "Frequency of Candida spp. in the oral cavity of Brazilian HIV-positive patients and correlation with CD4 cell counts and viral load". *Mycopathologia.,* Feb; 167(2):81-7.

Baradkar, S. Kumar. 2009. "Species Identification of Candida isolates obtained from oral lesions of HIV infected patients"; *Indian J. Dermatol.,* 54(4):385-6.

Changdeo, S. Aher, 2014. "Species distribution, virulence factors and antifungal susceptibility profile of Candida isolated from Oropharyngeal lesions of HIV infected patients"; *Int. J. Curr. Microbiol. App. Sci,* 3(1): 453-460.

Cynthia L. Kleinegger, Shawn R. Lockhart, Kaaren Vargas, and David R. Soll. 1996. "Frequency, Intensity, Species, and Strains of Oral Candida Vary as a Function of Host Age"; *Journal of Clinical Microbiology,* p. 2246–2254 Vol. 34, No. 9.

Cyril Enwonwu and Valli Meekst: 1996. "Oral Candidiasis, HIV, and Saliva Glucocorticoids"; *American Journal of Pathology,* Vol. 148, No. 4.

David, A. Reznik, 2006. "Oral Manifestations of HIV Disease"; Perspective – Oral Manifestations Volume 13 Issue 5 December 2005/January 2006.

Deborah Greenspan, John S Greenspan: "HIV-related oral disease"; Lancet 1996; 348: 729–33.

Derek Sullivan and David Coleman: 1998. "Candida dubliniensis: Characteristics and Identification"; *Journal Of Clinical Microbiology,* p. 329–334 Vol. 36, No. 2.

Dronda, F., Alonso-Sanz, M., Laguna, F. 1996. "Mixed oropharyngeal candidiasis due to Candida albicans and non-albicans Candida strains in HIV-infected patients"; *European Journal of Clinical Microbiology and Infectious Diseases.,* Volume 15, Issue 6, pp 446-452.

Epstein, J.B. 2003. "Diagnosis And Treatment Of Oropharyngeal Candidiasis"; *Oral Maxillofacial Surg Clin N Am,* 15, 91–102.

Erick Nelo Pedreira, Camila Lopes Cardoso, Éder Do Carmo Barroso, Jorge André De Souza Santos: 2008. "Epidemiological and oral manifestations of hiv-positive patients in a specialize service in Brazil"; *J Appl Oral Sci.*, 16(6):369-75.

Fernanda Wirth and Luciano Z. Goldani: "Epidemiology of Rhodotorula, 2012. An Emerging Pathogen"; Interdisciplinary Perspectives on Infectious Diseases Volume, Article ID 465717, 7 pages.

Fernando Laguna, 1997. "Patterns of Fluconazole Susceptibility in Isolates from Human Immunodeficiency Virus—Infected Patients with Oropharyngeal Candidiasis Due to Candida Albicans"; *Clinical Infectious Diseases,* 24:124-30.

Foluso J. Owotade, Mrudula Patel, Tshakane R. M. D. Ralephenya, 2013. Oral Candida colonization in HIV-positive women: associated factors and changes following antiretroviral therapy"; *Journal of Medical Microbiology.,* 62, 126–132.

François L. Mayer, Duncan Wilson and Bernhard Hube, 2013. "Candida albicanspathogenicity mechanisms"; Virulence 4:2, 119–128; February 15, 2013; Landes Bioscience.

Gail Cherry-Peppers, Christine, Daniels, R. N. Valli Meeks. 2003. "Oral Manifestations In The Era Of Haart"; *Journal Of The National Medical Association,* Vol. 95, No. 2 (Suppl).

George, R. Thompson, Payal K. Patel, William R. Kirkpatrick, Steven D. Westbrook, Deborah Berg, Josh Erlandsen, 2010. "Oropharyngeal candidiasis in the era of antiretroviral therapy"; *Oral Surg Oral Med Oral Pathol Oral Radiol Endod.,* 109:488-495.

Giuseppe, A. 2009. Scardina, Alessia Ruggieri and Pietro Messina: "Chronic Hyperplastic Candidosis: a pilot study of the efficacy of 0.18% isotretinoin"; *Journal of Oral Science,* Vol. 51, No. 3, 407-410.

Hans Christian Korting, Markus Ollert, AlettaGeorgii and Monika Froschl, 1988. "In vitro susceptibilities and biotypes of candida albicans isolates from the oral cavities of patients infected with human immunodeficiency virus"; *Journal of Clinical Microbiology,* vol. 26, no. 12 p. 2626-2631N.

Jair C Leao, Camila Riberio, 2009. "Oral complications of HIV Disease"; Clinics, 64(5), 459-470.

Jeannette Guarner and Mary E Brandt. 2011. "Histopathologic Diagnosis of Fungal Infections in the 21st Century; *Clinical Microbiology Reviews",* P. 247–280.

John Hellstein, Holly Vawter-Hugart, David R. Soll. 1993. "Genetic Similarity and Phenotypic Diversity of Commensaland Pathogenic Strains of Candida albicans Isolated from the Oral Cavity"; *Journal Of Clinical Microbiology,* Vol. 31, No. 12 , p. 3190-3199.

Jon, A. Sangeorzan, MD, Suzanne, F. Bradley, MD, Xiaogang He, 1994. "Epidemiology of Oral Candidiasis in HIV-Infected Patients: Colonization, Infection, Treatment, and Emergence of Fluconazole Resistance"; *The American Journal of Medicine*, Volume 97; 339.

Jonathan Weber, 2013. "The pathogenesis of HIV-1 infection"; Jefferiss Research Laboratories, Wright-Fleming Institute, Imperial College School of Medicine, London, UK.

Jose L. Lopez-Ribot, Robert K. McAtee, Sofia Perea, Thomas F. Patterson, 1999. "Multiple Resistant Phenotypes of Candida albicans Coexist during Episodes of Oropharyngeal Candidiasis in Human Immunodeficiency Virus-Infected Patients"; Antimicrob. *Agents Chemother,* vol. 43 no. 7 1621-1630.

Jose, L. Lopez-Ribot, Robert K. Mcatee, Linda N. Lee, William R. Kirkpatrick. 1998. "Distinct Patterns of Gene Expression Associated with Development of Fluconazole Resistance in Serial Candida albicans Isolates from Human Immunodeficiency Virus-Infected Patients with Oropharyngeal Candidiasis"; *Antimicrobial Agents And Chemotherapy,* P. 2932–2937.

Juliana, C Junqueira Beth B Fuchs, Maged Muhammed, Eleftherios Mylonakis. 2011. "Oral Candida albicans isolates from HIV-positive individuals have similar in vitro biofilm-forming ability and pathogenicity as invasive Candida isolates"; *BMC Microbiology.,* 11:247.

Kantheti LP *et al*. 2012. "Isolation, identification, and carriage of Candidial species in PHLAs and their correlation with immunological status in cases with and without HAART"; *Journal of Oral and Maxillofacial Pathology:* Vol.16 Issue 1 Jan-Apr 2012,38.

Krcmery, V., Barnes, A.J. 2002. "Non-albicans Candida spp. causing fungaemia: pathogenicity and antifungal resistance". *J Hosp Infect.* 50 (4):243-60.

Laurence Millon, L. Agnes Manteaux, Gabriel Reboux, Christine Drobacheff, 1994. "Fluconazole-Resistant Recurrent Oral Candidiasis in Human Immunodeficiency Virus-Positive Patients: Persistence of Candida albicans Strains with the Same Genotype"; *Journal of Clinical Microbiology,* P. 1115-1118.

Laurie, A. MacPhail, Eugene Komaroff, Mario E. A. F. Alves, 2002. "Differences in risk factors among clinical types of oral candidiasis in the Women's Interagency HIV Study"; *Oral Surg. Oral Med. Oral Pathol. Oral Radiol. Endod.,* 93:45-55.

Louis de Repentigny, Daniel Lewandowski, Paul Jolicoeur. 2004. "Immunopathogenesis of Oropharyngeal Candidiasis in Human Immunodeficiency Virus Infection"; *Clinical Microbiology Reviews,* P. 729–759.

Marcos Martinez, José L, López-Ribot, William R. Kirkpatrick, Brent J. Coco, 2002. "Replacement of Candida albicans with C. dubliniensis in Human Immunodeficiency Virus-Infected Patients with Oropharyngeal Candidiasis Treated with Fluconazole"; *J. Clin. Microbiol.,* vol. 40 no. 9 3135-3139.

Mary, E. Brandt, Lee H. Harrison, Margaret Pass, 2000. "Candida dubliniensisFungemia: the First Four Cases in North America"; *Emerging Infectious Diseases,* 46 Vol. 6, No. 1.

Meurman, J.H., E. Siikala, M. Richardson and R. Rautemaa, 2007. "Non-Candida albicans Candida yeasts of the oral cavity"; Communicating Current Research and Educational Topics and Trends in Applied Microbiology; A Méndez-Vilas(Ed), 719-30.

Mine Yücesoy. 2003. "Performance of CHROMAGAR candida and BIGGY agar for identification of yeast species"; *Annals of Clinical Microbiology and Antimicrobials*, 2:8.

Molero, Rosalía Díez-Orejas, Federico Navarro-García, LucíaMonteoliva, JesúsPla, Concha Gil, 1998. "Candida albicans: genetics, dimorphism and pathogenicity"; *Internatl Microbiol,* 1:95–106.

Natalya, U. Makarova, V. V. Pokrowsky, A. V. Kravchenko, L. V. Serebrovskaya, Michael, J. 2003. "Persistence of Oropharyngeal Candida albicans Strains with Reduced Susceptibilities to Fluconazole among Human Immunodeficiency Virus-Seropositive Children and Adults in a Long-Term Care Facility"; *J. Clin. Microbiol.,* 41(5): 1833–1837.

Paul, L.. Fidel, Jr., Jose, A. Vazquez, and Jack D. Sobel. 1999. "Candida glabrata: Review of Epidemiology, Pathogenesis, and Clinical Disease with Comparison to C. albicans"; *Clinical Microbiology Reviews,* p. 80–96 Vol. 12, No. 1.

Payal, K. Patel, Joshua E. Erlandsen, William R. Kirkpatrick, Deborah, K. Berg, Steven, D. Westbrook. "The Changing Epidemiology of Oropharyngeal Candidiasis in Patients with HIV/AIDS in the Era of Antiretroviral Therapy". *AIDS Research and Treatment*; Article ID 262471.

Peter, J. Giannini, Kishore V. Shetty. 2011. "Diagnosis and Management of Oral Candidiasis"; *Otolaryngol Clin. N. Am.,* 44, 231–240.

Pfaller, M.A. Petter G Pappar, 2006. "Candida Guilliermondii: An Opportunistic Fungal Pathogen With Decreased Susceptibility To Fluconazole: Geographic And Temporal Trends From The Artemis Disk Antifungal Surveillance Program, *Journal Of Clinical Microbiology,* P. 3551–3556 Vol. 44, No. 10.

Prasanna Kumar Rao, 2012. "Oral Candidiasis – A Review"; *Scholarly Journal of Medicine,* Vol. 2(2) pp. 26-30.

Rachana, V. Prabhu, 2013. "Oral Candidiasis and HIV Infection"; *Journal of Contemporary Medicine.,* 3(3): 237 – 244.

Rajendra, J. Kothavade, M. M. Kura, Arvind G. Valand, 2010. "Candida tropicalis: its prevalence, pathogenicity and increasing resistance to fluconazole"; *Journal of Medical Microbiology.,* 59, 873–880.

Redding, S., Smith, J., Farinacci, G., Rinaldi, M. and Fothergill, A. 1994. "Resistance of Candida albicans to Fluconazole During Treatment of Oropharyngeal Candidiasis in a Patient with AIDS: Documentation by In Vitro Susceptibility Testing and DNA Subtype Analysis"; *Clin Infect Dis.,* 18 (2):240-242.

Reichart, P.A., Samaranayake, L.P. Philipsen, H.P. 2000. "Pathology and clinical correlates in oral candidiasis and its variants: a review"; *Oral Diseases.,* 6, 85–91.

Richard, J. Blinkhorn, David Adelstein and Philip J. Spagnuolo. 1989. "Emergence of a new Opportunistic Pathogen, Candida Lusitaniae"; *Journal of Clinical Microbiology,* p. 236-240 Vol. 27, No. 2.

Ruhnke, M., Eigler, A., Tennagen, I., Geiseler, B., Engelmann, E. and Trautmann, M. 1994. "Emergence of fluconazole-resistant strains of Candida albicans in patients with recurrent oropharyngeal candidosis and human immunodeficiency virus infection"; *J Clonical Microbiology,* vol32, No.9, 2012-2094.

Sachin C. Deorukhkar, Santosh Saini, and Stephen Mathew: 2004. "Virulence Factors Contributing to Pathogenicity of Candida tropicalisand Its Antifungal Susceptibility Profile"; *International Journal of Microbiology.,* Volume Article ID 456878, 6 pages.

Sardi, J. C. O., Scorzoni, L. Bernardi, T. Fusco-Almeid, A. M. 2013. "Candida species: current epidemiology, pathogenicity, biofilm formation, natural antifungal products and new therapeutic options"; *Journal of Medical Microbiology,* 62, 10–24.

Sharon Walmsley, Susan King, Allison McGeer, Yanna Ye, and Susan Richardson. 2001. "Oropharyngeal Candidiasis in Patients with Human Immunodeficiency Virus: Correlation of Clinical Outcome with In Vitro Resistance, Serum Azole Levels, and Immunosuppression"; CID 32.

Sofia Perea, José L. López-Ribot, William R. Kirkpatrick, Robert K. McAteeL. 2001. "Prevalence of Molecular Mechanisms of Resistance to Azole Antifungal Agents in Candida albicans Strains Displaying High-Level Fluconazole Resistance Isolated from Human Immunodeficiency Virus-Infected Patients"; *Antimicrob. Agents Chemother.* vol. 45 no. 102676-268.

Troillet, J. Bille, M. P. Glauser, J. P. Chave. 1993. "Correlation between in vitro susceptibility of Candida albicans and fluconazole-resistant oropharyngeal candidiasis in HIV-infected patients"; *European Journal of Clinical Microbiology and Infectious Diseases,* Volume 12, Issue 12, pp 911-915.

Usha Arora *et al*, 2003. "Oral Candidiasis in HIV sero-positive patients"; *Journal of Conservative Dentistry.,* Vol 6No.2.

Vijeta Maurya, Ashutosh Srivastava, Jyoti Mishra, Rajni Gaind, Rungmei S. K. Marak. 2013. "Oropharyngeal candidiasis and Candida colonization in HIV positive patients in northern India"; *J Infect Dev Ctries,* 7(8):608-613.

William, R. Kirkpatrick, Sanjay G. Revankar, Robert K. Mcatee, Jose L. Lopez-Ribot: "Detection of Candida dubliniensis in Oropharyngeal Samples from Human Immunodeficiency Virus-Infected Patients in North America by Primary CHROM agar Candida Screening and Susceptibility Testing of Isolates"; *J. Clin. Microbiol.,* vol. 36 no. 10 3007-3012.

Xlaogang He, Robert N. Tiballi, Lidija T. Zarins, Suzanne F. Bradley, Jon A. Sangeorzan, and Carol A. Kauffman,1994. "Azole Resistance in Oropharyngeal Candida albicans Strains Isolated from Patients Infected with Human Immunodeficiency Virus"; *Antimicrobial Agents And Chemotherapy*, p. 2495-2497 Vol. 38.

Yasuki Kamai, Mikie Kubota, Yoko Kamai, Tsunemichi Hosokawa, 2002. "Contribution Of Candida Albicans Als1 To The Pathogenesis Of Experimental Oropharyngeal Candidiasis"; *Infection And Immunity,* P. 5256–5258 Vol. 70, No. 9.

Yuthika, H. Samaranayake, and L.P. Samaranayake. 1994. "Candida krusei: biology, epidemiology, pathogenicity and clinical manifestations of an emerging pathogen"; *J. Med. Microbiol.,* Vol. 41, 295-310.

****