ISSN: 0975-833X

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

International Journal of Current Research
Vol. 11, Issue, 12, pp.8608-8612, December, 2019

DOI: https://doi.org/10.24941/ijcr.37326.12.2019

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

STUDY OF CANDIDA SPECIES FROM SUSPECTED CASES OF FUNGAL URINARY TRACT INFECTIONS AMONGST PEDIATRIC PATIENTS

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ARTICLE INFO

Article History:
Received 14th September, 2019
Received in revised form
28th October, 2019
Accepted 15th November, 2019
Published online 30th December, 2019

Key Words:
Candiduria,
Non Albicans Candida, UTI.

ABSTRACT

Fungal UTI is one of the important factor in mortality and morbidity in hospitalised patients especially in paediatric population. Our study was aimed to report the prevalence of *Candida* spp. amongst suspected cases of fungal UTI and determine its antifungal susceptibility profile. A total of 63 (31.5%) *Candida* spp. were isolated out of 200 urine specimens collected from pediatric patients. In our study, Non-*albicans Candida* species (57.14%) were the predominant isolates compared to *Candida albicans* (42.86%). Non-*albicans Candida* demonstrated high resistance to azoles. Therefore, it can be concluded that non-*albicans Candida* species has emerged as an important cause of urinary tract infections. Their isolation from clinical specimen can no longer be ignored as a nonpathogenic isolate nor can it be dismissed as a contaminant, since Candiduria may even be a marker of disseminated candidiasis.

Citation: Rawat Y., Malhotra S. and Duggal N. **2019.** "Study of candida species from suspected cases of fungal urinary tract infections amongst pediatric patients", *International Journal of Current Research*, 11, (12), 8608-8612.

INTRODUCTION

Fungal UTI has become an important nosocomial infection over the past decades amongst hospitalized patients especially in paediatric population. Spectrum of disease varies from asymptomatic candiduria to clinical sepsis. The diagnosis of UTI is often missed in infants and young children, as urinary symptoms are minimal and often non-specific. In neonates, UTI is usually a part of septicemia and presents with fever, vomiting, lethargy, jaundice and seizures. Multiple risk factors like prolonged hospitalisation, broad spectrum antibiotic therapy, use of indwelling catheters, total parenteral nutrition, renal and urinary tract abnormalities and prematurity have all contributed for candida infection (Da Silva, 2007; Saha *et al*., 2008). In India the situation is compounded by the presence of severe malnutrition in children which is responsible for considerable susceptibility to infections. Candiduria serves as an important predictor of candidemia in critically sick children which is the much more serious condition where Candida species breaches the mucosal membrane and enters the blood stream to disseminate to multiple organ system. In infants and children the clinical manifestation depends on the sites involved. Thus, frequent monitoring for colonization may help in predicting subsequent Candida infection in critically ill children in PICU.

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This offers opportunity for interventions such as prophylactic antifungal therapy to prevent candidemia and reduce the cost of ICU care. Recent epidemiological studies have indicated towards a mycological shift, and while C. *albicans* still remains the most common fungal isolate, its incidence has declined with increase in the frequency of other non-candida albicans species (Kojic, 2004; Chandra *et al*., 2001; Colombo *et al*., 2003). Resistance to azoles amongst *Candida* species continues to increase and is a matter of great concern as this is the most commonly used empirical therapy for suspected fungal UTIs. The susceptibility of *Candida* species to frequently used antifungal drugs differ in various degrees. It has been reported that non-*albicans* species, *C. glabrata*, *C. tropicalis*, *C. krusei*, *C. parapsilosis* and *C. lusitaniae* have had higher resistance rates against fluconazole than *C. albicans* (Al-Abeid, 2004). *C. krusei* is one of the rare isolates of candiduria that is intrinsically resistant to fluconazole (Quindos *et al*., 1999). Hence species level identification of *Candida* and their antifungal susceptibility pattern will help in accurate treatment of candiduria. However, the management of candiduria remains controversial. Some of the clinicians have believed that the presence of *Candida* spp. in urine samples is marked as harmless colonization, or lower tract infection. On the other hand, candiduria is well known as an important risk factor for invasive candidiasis with considerable morbidity and mortality (Manzano-Goyosso). The purpose of this study was to isolate and speciate candida species from urine of pediatric patients and to evaluate their antifungal drug resistance pattern to currently used antifungal therapeutic agents.

MATERIAL AND METHODS

This study was conducted in the Department of Microbiology at Dr. Ram Manohar Lohia Hospital, New Delhi from November'2015 to March'2017. Pediatric patients (age ≤ 16 years) were included in this study. Minimum of 200 urine samples were collected from Department of Pediatrics (WARDS/PICU/NICU) from suspected cases of fungal UTI. Patients with bacterial UTI or Candida species isolated in a mixture from urine culture or who were on antifungal therapy or completed antifungal therapy 1 week prior to the sample collection were excluded from this study. Wet mount preparations were examined for budding yeast cells and pus cells and culture was performed on Sabouraud's Dextrose Agar (SDA), Blood agar (5%SBA) and Mac Conkey agar plate. The plates were incubated aerobically at 37ºC for 24-48 hours. A colony count of $>10^5$ CFU/ml in pure culture was taken as significant. Further, characterization were done for identification of species based on colony morphology and germ tube test. Germ tube test was used to differentiate Candida albicans from other Candida species. Other tests performed were colour appearance on CHROM agar medium, morphology on corn meal agar, biochemical properties in sugar assimilation test. Two consecutive urine samples positive for yeast cells and culturing the same candida species was considered as causing UTI and the risk factors like prolonged hospitalization, broad spectrum antibiotics, catheterization, immunosuppression etc. were assessed in such patients. Antifungal susceptibility testing was done by disc diffusion method as per CLSI guidelines (M44-A2) for the antifungals fluconazole (25µg) and voriconazole (1µg) (HiMedia laboratories Pvt. Ltd, Mumbai). Minimum Inhibitory Concentration (MIC) for antifungals were further determined using E- test method (HiMedia laboratories Pvt. Ltd, Mumbai). All freshly prepared medias were tested using quality control strains ATCC 90028 (Candida albicans), ATCC 13803 (C. tropicalis), and ATCC 6258 (C. krusei). The data was entered in MS EXCEL spreadsheet and analysis was done using Statistical Package for Social Sciences (SPSS) version 21.0.

RESULTS

In our study, the isolation of *Candida* species amongst 200 pediatric patients suspected of fungal UTI was found to be 63 (31.50%). Candiduria was predominant amongst males (66.67%) compared to females (33.33%). The age range for most of the patients affected with candiduria was found to be less than 1 year (61.91%) followed by 1 – 6 yrs (20.63%), 6 - 12 yrs (11.11%) and 12 – 16 yrs (6.35%) (Table 1). Maximum cases of candiduria were isolated from ICUs (38.46% NICU and 28.75% PICU) compared to wards (27.27%) (Table 2). In the present study, non albicans candida species has emerged as the predominant pathogen accounted for 57.14% while Candida albicans was 42.86% (Table 3). Amongst non-*albicans Candida* species most common isolate was *C. tropicalis* (31.75%), followed by *C.parapsilosis* (11.11%), *C. krusei* (9.52%) and *C.glabrata* (4.76%) respectively (Fig. 1). All the 63 (100%) Candida isolates were found to be susceptible to Voriconazole whereas susceptibility to Fluconazole was found in 46 (73.02%) *Candida* isolates. *C. albicans* were found to be susceptible to Fluconazole in 24 (88.89%) out of the 27 isolates however 2 isolates were resistant and 1 isolate was found to be having dose dependant susceptibility. In *C. tropicalis*, 15 (75.5%) out of the 20 isolates were found to be susceptible to Fluconazole and remaining 5 (25%) were resistant. All the 7 isolates of *C. parapsilosis* were susceptible to Fluconazole. None of the isolates of *C. krusei* and *C. glabrata* were found susceptible to Fluconazole (Table 4). The MIC of Voriconazole was found within susceptible range for all isolates of *Candida* species. The MIC of Fluconazole was found to be within the susceptible range for 46 out of 63 *Candida* isolates. The isolates having MIC within the susceptible range constituted 24 out of 27 isolates of *C. albicans,*15 out of 20 isolates of *C. tropicalis* and all the 7 isolates of *C. parapsilosis* were susceptible. All isolates of *C. krusei* (6) and *C. glabrata* (3) were found to be resistant to Fluconazole. In our study, the mean MIC of Fluconazole was found to be higher in non-*albicans* (0.5 ± 0.28 µg/ml) as compared to *C.albicans* (0.42 ± 0.22 µg/ml). (Table 5)

DISCUSSION

It has been reported that 11 to 52% of nosocomial urinary tract infections (UTIs) are caused by *Candida* spp (Febre, 1999; Weinstein *et al*., 2001; Richards; Brindha, 2011; Pourakbari, 2012; Bouza, 2001). In the present study, the isolation rate of *Candida* species was found to be 31.50% which is much higher than the study done by *Seifi Z et al*. (5.2%) and Gholamipour *et al*. (4.3%) in Iran.[226,227] However, a study performed in Kuwait and Brazil reported an isolation rate of 15.7% and 22% (Al Benwan *et al*., 2010; Fidel, 1999). Although females have higher risk for developing candiduria, In our study, *Candida* was isolated more commonly in males (66.67%) compared to females (33.3 %). This finding is in concordance with the study conducted by *Seifi Z et al*., Malhotra *et al* and jain *et al*. where 71.4%, 58.3% and 68% of *Candida* was isolated in males and 28.6%, 41.7% and 32% in females (Seifi, 2013; Robinson, 2009; Malhotra, 2014).The age range for most of the patients affected with candiduria was found to be less than 1 year.

In our study, majority of children with candiduria were hospitalized in ICU's { PICU (28.75%) and NICU (38.46%)} while (27.27%) isolates were from childrens admitted in wards. This is due to the fact that ICU patients are critically ill, immunocompromised and are mostly catheterised which are important risk factors for candiduria, leading further to candidaemia. Also the ICU patients receive multiple broad spectrum antimicrobial agents which further increase the prevalence of candiduria in ICUs (Sobel, 2001). Historically, C. *albicans* accounts for 70-80 % of clinical isolates, while other non-candida *albicans* species occur rarely. However, in the last few decades the prevalence of non-candida albicans Candida (NCAC) species have increased significantly (Manzano-Goyosso, 2000; Harris, 1999; Kauffman, 2000; Ruan, 2008). In our study, Non-*albicans Candida* species (57.14%) were the predominant isolates compared to *Candida albicans* (42.86%). Amongst non-*albicans Candida* species most common isolate were *C. tropicalis* (31.75%), followed by *C.parapsilosis* (11.11%), *C. krusei* (9.52%) and *C.glabrata* (4.76%) respectively This increased involvement of NCAC species may be due to improvements in the diagnostic methods, such as the use of differential agars(CHROMagar etc.) as well as the introduction of molecular techniques. This changing trends towards NCAC species has also been reported by other authors too (Yashavanth *et al*., 2013;

Table 1. Age distribution amongst isolates wrt gender

Age distribution	Gender		Total
	FEMALE	MALE	
1)>0-1 month	9 (30%)	21 (70%)	30 (100.00%)
2) >1month-12 months	3 (33.33%)	6 (66.67%)	9 (100.00%)
3) >1-6 years	3 (23.08%)	10 (76.92%)	13 (100.00%)
4) >6-12 years	2 (28.57%)	5 (71.43%)	7 (100.00%)
5) >12-16 years	4 (100%)	0 (0%)	4 (100.00%)
Total	21 (33.33%)	42 (66.67%)	63 (100.00%)

Table 2. ICU/ Ward wise distribution of Candiduria patients

Pediatric units	No Growth	Patient with candiduria	Total
NICU	40 (61.54%)	25 (38.46%)	65 (100.00%)
PICU	57 (71.25%)	23 (28.75%)	80 (100.00%)
WARD	40 (72.73%)	15 (27.27%)	55 (100.00%)
Total	137 (68.50%)	63 (31.50%)	200 (100.00%)

Table 3. Species distribution

Species	Number of isolates	Percentage
C. albicans	27	42.86%
Non albicans candida	20	57.14%
Total	63	100%

Table 4. Antifungal susceptibility pattern of Candida isolates

Isolate	Voriconazole		Fluconazole		Total
	R	S	R	S	
C.albicans	0 (0%)	27 (100.00%)	2 (7.41%)	24 (88.89%)	27*(100.00%)
C.glabrata	0 (0%)	3 (100.00%)	3 (100.00%)	0 (0.00%)	3 (100.00%)
C.krusei	0 (0%)	6 (100.00%)	6 (100.00%)	0 (0.00%)	6 (100.00%)
C.parapsilosis	0 (0%)	7 (100.00%)	0 (0.00%)	7 (100.00%)	7 (100.00%)
C.tropicalis	0 (0%)	20 (100.00%)	5 (25.00%)	15 (75.00%)	20(100.00%)
Total		63 (100.00%)	16 (25.40%)	46 (73.02%)	63(100.00%)

R – Resistant S – Sensitive * 1 (3.70%) isolate of *C. albicans* was found to be having dose dependant susceptibility to Fluconazole.

Table 5. Mean MIC of Voriconazole & Fluconazole for Non albicans Candida (NAC) & C. albicans (For susceptible isolates)

	NAC	C. albicans
MIC-F (in µg/ml)		
Sample size	22	24
Mean ± Sd*	0.5 ± 0.28	0.42 ± 0.22
Median	0.44	0.38
Min-Max	0.09-1	0.12-1
MIC-V (in µg/ml)		
Sample size	36	27
Mean ± Sd	0.22 ± 0.22	0.11 ± 0.16
Median	0.12	0.06
Min-Max	0.02-0.75	0.03-0.75

* The mean MIC of Fluconazole was found to be higher in non-*albicans Candida* as compared to C. *albicans.*

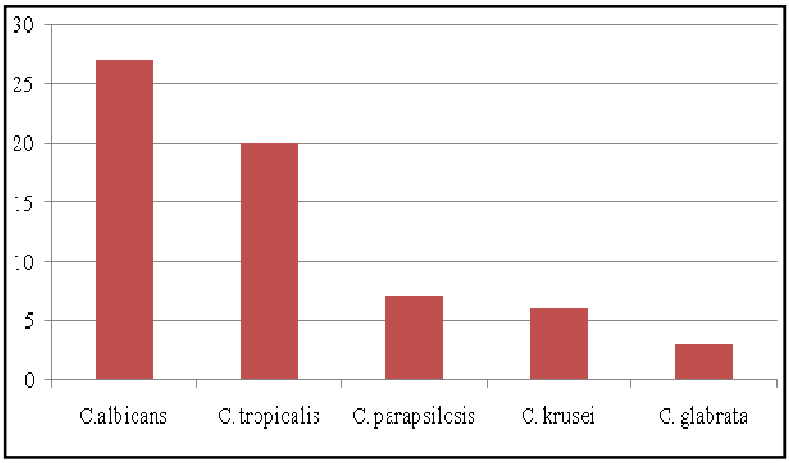

Figure 1.

Paul *et al*., 2017; Kobayashi *et al*., 2004). There is also inherently higher level of antifungal drug resistance reported amongst NCAC species compared with C. albicans (Kauffman *et al*., 2000). This changing trends in the aetiopathogenesis of urinary tract infections and considerable increase in number of non- *albicans Candida* species is a matter of concern (Ochipinti, 1994). Resistance to azoles amongst *Candida* species continues to increase and is a matter of great concern as this is the most commonly used empirical therapy for suspected fungal UTIs. The susceptibility of *Candida* species to frequently used antifungal drugs differ in various degrees. It has been reported that non-*albicans* species, *C. glabrata*, *C. tropicalis*, *C. krusei*, *C. parapsilosis* and *C. lusitaniae* have had higher resistance rates against fluconazole than *C. albicans* (Al-Abeid, 2004). *C. krusei* is one of the rare isolates of candiduria that is intrinsically resistant to fluconazole (Quindos *et al*., 1999). Hence species level identification of *Candida* and their antifungal susceptibility pattern will help in accurate treatment of candiduria. However, the management of candiduria remains controversial. Some of the clinicians believe that the presence of *Candida* spp. in urine samples is marked as harmless colonization, or lower tract infection. On the other hand, candiduria is well known as an important risk factor for invasive candidiasis with considerable morbidity and mortality (Manzano-Goyosso, 2008). Clinically two important antifungals, amphotericin B and fluconazole have been used for the treatment of candiduria in patients (Kauffman, 2000; Hollenbach, 2008).

In our study, all the 63 (100%) Candida isolates were found to be susceptible to Voriconazole. Susceptibility to Fluconazole was found in 46 (73.02%) *Candida* isolates whereas 25.40% (16) of *Candida* isolates were resistance to fluconazole. This is comparable to the study reported by Mahmoudabadi A *et al*. which showed 21.9% resistance to fluconazole. Resistance to fluconazole was also observed in various studies (Seifi, 2013, de Freitas, 2014 and Mishra, 2014). Out of 16 resistant isolates 7.41% (2) were *C. albicans* and 38.89% (14) were non-*albicans*. This finding can be explained by the fact that NCAC species are more resistant to antifungal drugs compared to *C. albicans*. Among non-albicans *C. krusei and C. glabrata* constituted 6 and 3 isolates respectively. All of them was found to be resistant to fluconazole as they are innately resistant to fluconazole (Arıkan, 2007). In our study, the mean MIC of fluconazole was found to be higher in non-*albicans* (0.5 ± 0.28 µg/ml) as compared to *C.albicans* (0.42 ± 0.22 µg/ml). In our study reduced susceptibility as well as frank resistance to fluconazole is observed and is an issue of crucial importance in premature or immunocompromised patients with serious infections. Fluconazole is a first choice drug for treatment because of high concentration of active drug attained in urine, cost effectiveness, safety and better tolerance. Hence antifungal susceptibility testing by automated or manually with disc diffusion, E-test or broth dilution method is a promising tool for predicting the efficacy of a given antifungal agent. In our study similar results for sensitivity were obtained both by E-test and disc diffusion.

Conclusion

NAC spp. have emerged as an important cause of urinary tract infections. Its isolation from clinical specimens can no longer be ignored as non-pathogenic isolate nor can it be dismissed as a contaminant. Proper surveillance of these fungal pathogens is important to improve quality of care in tertiary care setting. Candiduria is an increasingly difficult problem for clinicians to recognize and manage especially in infants as they do not present with typical symptoms of UTI. Candiduria may lead to disseminated candidiasis especially hospitalized patients in ICUs, as they are immunocompromised, catheterized and on prolonged antibiotics. It is important that the specific species responsible for symptomatic infection is identified because non-albicans *Candida* are more resistant to commonly used antifungals and also few species are intrinsically resistant to fluconazole. Since our study indicates the upcoming resistance of Candida species to the antifungal agents in use, hence it is of utmost importance not only to identify Candida up to species level but also to determine its antifungal susceptibility pattern in wake of azole being used for empirical therapy.

REFERENCES

Al Benwan K., Al Sweih N., Rotimi VO. 2010. Etiology and antibiotic susceptibility patterns of community- and hospital- acquired urinary tract infections in a general hospital in Kuwait. Med Princ Pract. 2010; 19(6): 440-6.

Al-Abeid HM., Abu-Elteen KH., Elkarmi AZ., Hamad MA. 2004. Isolation and characterization of Candida spp. in Jordanian cancer patients: prevalence, pathogenic determinants, and antifungal sensitivity. *Jpn J Infect Dis*., **57**(6):279-84.

Arıkan S., Rex JH. 2007. Antifungal agents. In: Murray PR, Baron EJ, Jorgensen JH, Landry ML, Pfaller MA, (eds). *Manual of Clinical Microbiology*, 9th ed. Washington, DC: ASM Press; 1949 – 1960.

Bouza E., San Juan R., Munoz P. *et al*., 2001. A European perspective on nosocomial urinary tract infections II. Report on incidence, clinical characteristics and outcome (ESGNI− 004 study). *Clin Microbiol Infect.,* 7:532-42.

Brindha S., Jayashree M., Singhi S. *et al*., 2011. Study of nosocomial urinary tract infections in a pediatric intensive care unit. *J Trop Pediatr*., 57:357-62.

Chandra J., Kuhn DM., Mukherjee PK. *et al*. 2001. Biofilm formation by the fungal pathogen Candida albicans: development, architecture and drug resistance. *J Bacteriol.*, 183: 5385-5394.

Colombo AL., Perfect J., DiNubile M. *et al*. 2003. Global distribution and outcomes for Candida species causing invasive candidiasis: results from an international randomized double-blind study of caspofungin versus amphotericin B for the treatment of invasive candidiasis. *Eur J Microbiol Infect Dis.,* 22: 470-474.

Da Silva EH, Da Silva Ruiz L, Matsumoto FE, Auler ME, Giudice MC. *et al*. 2007. Candiduria in a public hospital of São Paulo (1999-2004): characteristics of the yeast isolates. Rev Inst Med trop S Paulo 49: 349-353.

de Freitas AR., Baeza LC., Faria MG., Dota KF., Godoy Martinez P., Svidzinski TI. 2014. Yeasts isolated from nosocomial urinary infections: antifungal susceptibility and biofilm production. *Rev Iberoam Micol*., 31(2):104-8.

Febre N., Silva V., Medeiros E. *et al*., 1999. Microbiological characteristics of yeasts isolated from urinary tracts of intensive care unit patients undergoing urinary catheterization. *J Clin Microbiol*., 37:1584-6.

Fidel PL., Vasquez JA., Sobel JD. 1999. Candida glabrata: review of epidemiology, pathogenesis, and clinical disease with comparison to Candida albicans. *Clin Microbiol Rev.*, 12:80–96.

Harris AD., Castro J., Sheppard DC. *et al*. 1999. Risk factors for nosocomial candiduria due to Candida glabrata and Candida albicans. *Clin Infect Dis*., 29: 926-928

Hollenbach E., 2008. To treat or not to treat – critically ill patients with candiduria. *Mycoses*. 51(Suppl 2): 12-24.

Kauffman CA, Vasquez JA, Sobel JD, *et al*..Prospective multicenter surveillance study of funguria in hospitalized patients. Clin Infect Dis 2000;30: 14-18.

Kobayashi CC., De Fernandes OF., Miranda KC., De Sousa ED., Silva Mdo R. 2004. Candiduria in hospital patients: A study prospective. *Mycopathologia.*, 158:49-52.

Kojic EM., Darouiche RO. 2004. Candida infections of medical devices. *Clin Microbiol Rev.,*17: 255-267

Mahmoudabadi A, Matehkolaei A R, Navid M, Torabizadeh M, Mazdarani S. Colonization and antifungals susceptibility patterns of *Candida* species isolated from hospitalized patients in ICUs and NICUs. J Nephropathol. 2015;4(3):77-84.

Malhotra, S., Sharma, S., Bhatia, N. J. K., Jangid K. and Hans, C. 2014. Prevalence of Candiduria in Infants from a Tertiary Care Hospital;International Journal of TROPICAL DISEASE & Health, 4(11): 1191-1197.

Manzano-Goyosso P., Hernández–Hernández F., *et al*. 2008. Candiduria in type 2 diabetes mellitus patients and its clinical significance. Candida spp antifungal susceptibility. *Rev Med Inst Mex Seguro Soc.,* 46: 603-610.

Mishra M., Agrawal S., Raut S., Kurhade AM., Powar RM. 2014. Profile of yeasts isolated from urinary tracts of catheterized patients. *J Clin Diagn Res*., 8(2):44-6.

Ochipinti DJ., Gubbins PO., Schreckenberger P., Danziger LH. 1994. Frequency pathogenicity and microbiologic outcome of non Candida albicans candiduria. *Europ J Clin Microbiol Infect Dis.,* 13:459–67.

Paul N., Mathai E., Abraham OCA., Michael JS., Mathai D. 2007. Factors associated with candiduria and related Mortality. *J Infect.,*55:450-5.

Pourakbari B., Rezaizadeh G., Mahmoudi S. *et al*., 2012. J Prev Med Hyg., 53:204-6.

Quindos G., Abarca L., Carrillo-Munoz AJ., Arevalo MP., Bornay FJ., Casals JB. *et al*., 1999. Multicenter survey of in vitro antifungal resistance in yeasts of medical importance isolated from Spanish patients. *Rev Iberoam Micol*., 16(2):97-100.

Richards MJ., Edwards JR., Culver DH. *et al*. Nosocomial infections in combined medical-surgical intensive care units in the United States. Infect Control Hosp Epidemiol 2000; Epidemiology of nosocomial infections in pediatric patients in an Iranian referral hospital. 21:510-5.

Robinson JL., Davies HD., Barton M., O'Brien K., Simpson K., Asztalos E. 2009. Characteristics and outcome of infants with candiduria in neonatal intensive care - a Paediatric Investigators Collaborative Network on Infections in Canada (PICNIC) study. BMC Infect Dis., 9: 183.

Ruan SY., Chen SY., Husek PR. 2008. Persistent Candida parapsilosis funguria associated with indwelling urinary tract stent for more than 7 years. *J Med Microbiol.*, 57:1585-1587.

Saha R., Das S., Kumar A., Kaur IR. 2008. Pattern of Candida isolates in hospitalized children. Indian J Pediatr 75: 858-860.

Seifi Z., Azish M., Salehi Z., Mahmoudabadi A., Shamsizadeh A. 2013. Candiduria in children and susceptibility patterns of recovered Candida species to antifungal drugs in Ahvaz. Journal of Nephropathology; 2(2): 122-128.

Sobel JD., Fisher JF., Kauffman CA., Newman CA. 2011. Candida urinary tract infections epidemiology. *Clin Infect Dis.,* 52(6):433-6

Weinstein RA., Lundstrom T., Sobel J., 2001. Nosocomial candiduria: a review. *Clin Infect Dis.,* 32:1602-7.

Yashavanth R., Shiju M.P., BhaskarU.A. Ronald R., Anita K.B. 2013. Candiduria: Prevalence and Trends in Antifungal Susceptibility in A Tertiary Care Hospital of Mangalore: Journal of Clinical and Diagnostic Research. Nov, Vol-7(11): 2459-2461

Gholamipour P. S. Mahmoudi, Pourakbari B, Taghi haghi ashtiani, sabouni F, Teymuri M. Mamishi S. 2014. Candiduria in children: a first report from an Iranian referral pediatric hospital *J prev med hyg.,* 55: 54-57.

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