Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Microbiology Research

Journal homepage: www.ijmronline.org

Original Research Article

Changing trends in candidemia: A four-year prospective study at a rural tertiary care hospital

Nidhi Mihirkumar Bhalodia[1*], Som Lakhani[2], Mihirkumar J Bhalodia[3], Tanuja Javadekar[1], Sucheta Lakhani[1]

[1]Dept. of Microbiology, SBKSMI&RC, Sumandeep Vidyapeeth (Deemed to be University), Vadodara, Gujarat, India
[2]Dept. of Dermatology, Parul Institute of Medical Sciences and Research, Parul University, Vadodara, Gujarat, India
[3]Dept. of Pathology, SBKSMI&RC, Sumandeep Vidyapeeth (Deemed to be University), Vadodara, Gujarat, India

Abstract

Background: *Candida* spp. are opportunistic fungal pathogens causing invasive bloodstream infection among immunocompromised and hospitalised patients. Though *Candida albicans* is the most common causative species, the incidence of non-albicans species like *Candida glabrata, Candida parapsilosis, Candida tropicalis, and Candida krusei* is increasing at alarming rate.
Aims & Objective: The main aim of present study is to compare incidence of *Candida albicans* and non-albicans over the period of 4 years and to determine species distribution of candida isolated from blood samples of patients.
Materials & Methods: The present single-centered prospective study was conducted at rural-based tertiary care hospital in Vadodara for 4 years. Two blood culture samples were collected per patient and incubated for 5 days in an automated blood culture system (BACTEC FX40). The species identification and antifungal susceptibility testing was done by VITEK (bioMerieux) automated system. Antifungal susceptibility test was performed using YST08 cards.
Result: Out of total 4528 blood culture samples, *Candida spp*. were isolated from 143 samples (3.1%). The prevalence of candidemia was 25 cases (0.5%) in 2021, 34 cases (0.7%) in 2022, 36 cases (0.8%) in 2023, with a significant increase to 48 cases (1.06%) in 2024. Out of the total 143 candida isolates, there were 28 *Candida albicans* and 115 Candida non-albicans isolates. Among non-albicans isolates, the prevalence of *Candida tropicalis* (32.8%) was highest. The prevalence of candidemia was highest 50.3%, among 41-60 years age group. The most common risk factors associated with candidemia was diabetes mellitus (51.74%), central venous catheterisation (32.16%), long term steroid therapy (23.77%) and use of broad spectrum antibiotics (48.95%).In our study sensitivity of candida non-albicans to azole group of drugs was less as compared to *Candida albicans.*
Conclusion: The emergence of highly resistant isolates emphasises the current need for constant surveillance and monitoring of candidemia cases.

Keywords: Blood culture, Candidemia, *Candida tropicalis*, Diabetes mellitus.

Received: 03-03-2025; **Accepted:** 06-06-2025; **Available Online**: 01-07-2025

1. Introduction

Candida species are opportunistic fungal pathogens causing invasive bloodstream infection among immunocompromised and hospitalised patients.[1] According to various multicentric studies from the United States candidemia is the fourth common healthcare-associated bloodstream infection (BSI).[2-4]

Candida spp. are commensal which are normally found on the human skin surface and intestinal microbiota. *Candida spp*. can cause disease when the equilibrium among commensal organisms is disturbed.[5,6] The excessive use of antibiotics leads to suppression of normal flora and increases the incidence of candidemia.[7-9]

Mainly, patients admitted to intensive care units, those undergoing gastrointestinal surgical procedures, neutropenic patients, patients with an indwelling central venous catheter, on parenteral nutrition are at higher risk for developing invasive candidal infection.[10,11] Among the elderly population, various comorbid conditions such as diabetes

*Corresponding author: Nidhi Mihirkumar Bhalodia
Email: nidhi7jivani@gmail.com

https://doi.org/10.18231/j.ijmr.2025.028

mellitus, liver disease, hematological malignancy and malnutrition may predispose to candidiasis.[3]

Though *Candida albicans* is most common causative species, incidence of non-albicans species like *Candida glabrata, Candida parapsilosis, Candida tropicalis* and *Candida krusei* is increasing at an alarming rate. *Candida auris* has emerged as a major fungal pathogen causing a wide spectrum of healthcare-associated infections worldwide.[4,8] The development of resistance to commonly used antifungal drugs such as fluconazole, ketoconazole and echinocandins led to diagnostic and therapeutic challenges.[12,13]

The gold standard test for diagnosing candidemia is a positive blood culture. The sensitivity of blood culture is lower, and the turnaround time is longer. The blood culture may show false negative result if sample collection is not appropriate. For better diagnostic accuracy blood culture must be combined with other immunological tests and surrogate biomarkers such as Candida mannan antigen test and β-d-glucan (BDG) test.[3,4,14,15]

Thus, continuous surveillance is required to monitor recent trends in local incidence of candidemia. This present study was carried out to study prevalence of candidemia at rural based tertiary care hospital. In our study, associated risk factors and antifungal susceptibility profile of both *Candida albicans* and non-albicans were evaluated. This will guide both clinicians and microbiologists in formulating empirical antifungal therapy. This study will aid in identifying high risk population, and in such patients we can imply rapid biomarker test for early diagnosis of invasive candidiasis. The major limitation of the study was that rapid testing was not done which could have increased sensitivity of blood culture.

2. Material and Methods

The present prospective single-cantered study was conducted in a 3000-bed rural-based tertiary care hospital in Vadodara for 4 years (October 2020 to November 2024). It was carried out after approval by the institutional ethics committee (SVIEC/ON/MEDI/RP/19024).

Candidemia was defined as isolation of any *Candida spp*. from one or more blood culture from suspected cases of septicemia. All patients diagnosed with candidemia were included in our study.

Two blood culture samples (aerobic and anaerobic) were collected per patient with all aseptic precautions before antibiotic therapy and immediately transported to the microbiology laboratory. Blood culture was incubated for 5 days in an automated blood culture system (BACTEC FX40). Gram staining was performed from a blood culture bottle, which flagged positive.

In case of positive blood culture, streaking was done on Blood Agar and Sabouraud dextrose agar (SDA) agar. To differentiate between *Candida albicans* and non albicans, the germ tube test was performed. The species identification was done on the basis of morphology and colony color on CHROM agar. The species confirmation was done by VITEK (bioMerieux) automated system using yeast identification card. Antifungal susceptibility test was performed using YST08 cards in Vitek following Clinical and Laboratory Standards Institute guidelines.[16] The antifungal panel included following drugs Amphotericin B, Fluconazole, Voriconazole Micafungin, Caspofungin and Flucytosine.

2.1. Quality control strains

Candida albicans ATCC 90028, *Candida tropicalis* ATCC 750, *Candida krusei* ATCC 6258, and *Candida parapsilosis* ATCC 90018 were used

2.2. Statistical methods

All data were collected and organised in Microsoft Excel format and analysis was done using Epi Info statistical software. For the analytical analysis of data Chi-square test was performed to establish the significant association between various risk factors. All the study data was presented in form of tables and graphs.

3. Results

During four years, a total of 4528 blood culture samples from suspected cases of sepsis were received. Out of which *Candida species* were isolated from 143 samples (3.1%). An increase in the incidence of *Candida spp*. was noted over 4-year study period. The prevalence of candidemia was 25 cases (0.5%) in 2021, 34 cases (0.7%) in 2022, 36 cases (0.8%) in 2023, with significant increase to 48 cases (1.06%) in 2024. (**Table 1** & **Figure 1**)

Table 1: Distribution of candidemia cases over 4 years

Year	Total cases of sepsis (n=4528)	Total No. of Candidemia cases (n=143)	Total No. of Non-Candidemia cases (n=4385)	Chi-square	P value
2021	1136	25	1111	10.58	0.014 Significant
2022	1092	34	1058		
2023	1250	36	1214		
2024	1050	48	1002		

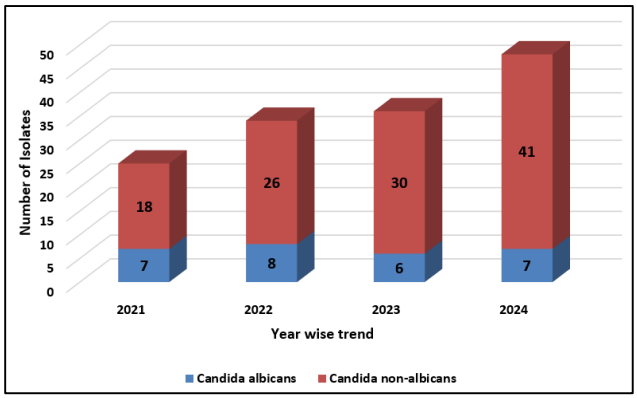

Figure 1: Year wise distribution of Candida spp. from 2021 to 2024

Among 143 patients, there were 67 patients from ICUs, 27 patients from surgical wards, 10 patients from oncology units, 24 patients from pulmonary medicine units and 15 patients from pediatric ward. The prevalence of *Candida albicans* (57.14%) and non-albicans (44.34%) was higher in intensive care units as compared to wards. (**Table 2**)

Out of the total 143 candida isolates, there were 28 *Candida albicans* and 115 Candida non-albicans isolates. Among non-albicans isolates, the prevalence of *Candida tropicalis* (32.8%) was highest, followed by *Candida glabrata* (14.6%), *Candida parapsilosis* (13.2%), *Candida guillermondii* (11.1%), *Candida rugosa* (5.5%), and *Candida famata* (2.7%). (**Figure 2**)

Among 143 total patients, there were 87 male patients and 56 female patients. Among 87 male patients *Candida albicans* was isolated in 18 patients and Candida non-albicans in 69 patients. Among 56 female patients *Candida albicans* was isolated in 10 patients and Candida non-albicans in 46 patients. There was no significant difference in the incidence of candidemia among male and female patients (P value >0.05).

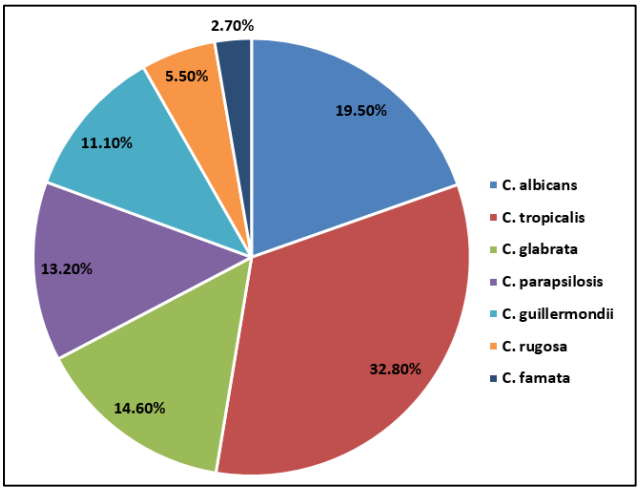

Figure 2: Distribution of different *Candida spp.*

The prevalence of candidemia according to age is shown in **Table 3**.

The most common risk factors associated with candidemia were diabetes mellitus (51.74%), central venous catheterisation (32.16%), long-term steroid therapy (23.77%), and use of broad-spectrum antibiotics (48.95%).

In our study use of broad-spectrum antibiotics and diabetes mellitus were statistically higher in cases of candidemia caused by Candida non-albicans with P value less than 0.05 (**Table 4**).

Table 2: Distribution of *Candida spp.* according to various department

S. No.	Inpatient Location	*Candida albicans* (n=28)	*Candida non-albicans* (n=115)	Total
1	Intensive care units	16 (57.14%)	51 (44.34%)	67
2	Surgical Wards	5	22	27
3	Oncology units	1	9	10
4	Pulmonary Wards	4	20	24
5	Paediatric Ward	2	13	15

Table 3: Age wise distribution of *Candida spp.*

S. No.	Age	*Candida albicans* n=28	*Candida non-albicans* n=115	Total (n=143)	% candidemia
1	0-20	4	12	16	11.1%
2	21-40	6	23	29	20.2%
3	41-60	11	61	72	50.3%
4	>60	7	19	26	18.1%

Table 4: Evaluation of risk factors of candidemia

S. No.	Risk factor	*Candida albicans* n=28	*Candida non-albicans* n=115	Total No,%	P value
1	Diabetes mellitus	9	65	74 (51.74%)	0.02
2	Central venous catheter	7	39	46 (32.16%)	0.36
3	Total parental nutrition	3	12	15 (10.48%)	0.96
4	Cardiovascular disease	2	15	17 (11.88%)	0.38
5	HIV	1	7	8 (5.5%)	0.60
6	Chronic renal disease	1	19	20 (13.98%)	0.07
7	Liver disease	2	4	6 (4.19%)	0.38
8	Malignancy	1	9	10 (6.99%)	0.42
9	Post organ transplantation	-	1	1 (0.69%)	0.28
10	Long term steroid therapy	3	31	34 (23.77%)	0.07
11	Broad spectrum antibiotics	8	62	70 (48.95%)	0.016

Table 5: Antifungal susceptibility pattern of *Candida albicans* and non-albicans

S. No.	Antifungal	*C. albicans* n=28	*C. tropicalis* n=47	*C. glabrata* n=21	*C. parapsilosis* n=19	*C. guillermondii* n=16	*C. rugosa* n=8	*C. famata* n=4
1	Amphotericin B	21 (75%)	42 (89.36%)	20 (95.23%)	18 (94.73%)	16 (100%)	8 (100%)	4 (100%)
2	Fluconazole	16(57.14%)	34 (72.34%)	6 (28.57%)	5 (26.31%)	4 (25%)	3 (37.5%)	1 (25%)
3	Voriconazole	18 (64.28%)	36 (76.59%)	8 (38.09%)	9 (47.36%)	6 (37.5%)	5 (62.5%)	2 (50%)
4	Caspofungin	19 (67.85%)	40 (85.10%)	10 (47.61%)	8 (42.10%)	10 (62.5%)	6 (75%)	3 (75%)
5	Micafungin	18 (64.28%)	39 (82.97%)	9 (42.8%)	9 (47.36%)	9 (56.25%)	5 (62.5%)	2 (50%)
6	5-Flucytosine	17(60.71%)	35 (74.46%)	8 (38.09%)	7 (36.84%)	8 (50%)	4 (50%)	2 (50%)

4. Discussion

The incidence of *Candida spp*. infections have increased over the past few decades, particularly those caused by non-albicans candida. The important predisposing factor is overuse and misuse of antibiotics and steroids following the COVID-19 pandemic, which has led to a steady increase in the incidence of candidiasis.

Out of a total 4528 blood culture samples, *Candida spp*. were isolated from 143 samples (3.1%). A significant increase in the incidence of *Candida spp.* was noted over a 4-year study period (P value=0.014). Therefore, careful monitoring of these cases is essential to assess related risk factors and initiate empirical antifungal therapy. The prevalence of candidemia was 25 cases (0.5%) in 2021, 34 cases (0.7%) in 2022, 36 cases (0.8%) in 2023, with significant increase to 48 cases (1.06%) in 2024. In a similar study carried out at a tertiary hospital in western India by Ekadashi et al.[3] incidence of Candidemia was 2.8% (95 cases), with an increase in a number of cases from July 2017 to June 2020. In a study conducted by Bhattacharjee et al.[4] in 2016, the prevalence of candidemia was 4.03% from positive blood culture samples. In a study carried out at Moulana Azad Medical College, New Delhi, by Sahni et al.[11] incidence rate was 6.9%. Whereas Verma et al.[17] and Xess et al.[8] found incidence rates of 1.61% and 6% for candidemia, respectively.

Among 143 patients there were 67 patients from ICUs, 27 patients from surgical wards, 10 patients from oncology units, 24 patients from pulmonary medicine units and 15 patients from pediatric ward. The prevalence of *Candida albicans* (57.14%) and non-albicans (44.34%) was higher in intensive care units as compared to other wards. Our findings coincides with findings of Furnaleto et al.[15] and Ekadashi et al.[3] where prevalence of candidemia was statistically significant in ICU as compared to wards. The patients admitted to ICU are at higher risk of developing invasive candidiasis because of exposure to high dose antibiotics,

invasive procedures, underlying co-morbidities and presence of central lines.

Out of total 143 candida isolates there were 28 *Candida albicans* and 115 candida non-albicans isolates. In present study we found *Candida tropicalis* (32.8%) was the most predominant non-albicans species which is in line with other studies carried out in India which showed 35-45% prevalence of *Candida tropicalis.*[8,9,12,13]

In our present study we concluded that there was no significant difference in incidence of candidemia among male (n=87) and female patient (n=56). The prevalence of candidemia was highest among age-group 41-60 years (50.3%). Our findings are in contrast with that of Gupta et al.[2] who reported higher prevalence of Candida species among male patients.

The most common risk factors associated with candidemia were diabetes mellitus (51.74%), central venous catheterisation (32.16%), long term steroid therapy (23.77%) and use of broad spectrum antibiotics (48.95%).In our study use of broad -spectrum antibiotics and diabetes mellitus were statistically higher in cases of candidemia caused by candida non-albicans with P value less than 0.05. Our findings coincides with result of other studies by Giri et al,[14] Xess et al[8] and Chowta et al.[18] who concluded that prolonged use of antibiotics was significant risk factor for developing candidiasis as it alters commensal gut flora.

Candida albicans shows 75% sensitivity to Amphotericin B,57.14% sensitivity to Fluconazole, 64.28% sensitivity to Voriconazole and Micafungin, 67.85% to Caspofungin and 60.71% sensitivity to 5-Flucytosine.Among candida non-albicans *C.guillermondii*, *C.rugosa* and *C.famata* were 100% sensitive to Amphotericin B. Overall sensitivity of candida non-albicans to azole group of drugs was less as compared to candida albicans. Our results are similar to Kothari et al.[9] who reported 36% fluconazole resistance in candidemia isolates.

5. Conclusion

In our study, we concluded that there was a significant increase in cases of candidemia over a period of 4 years. Thus, constant surveillance of such cases is required for early diagnosis and prompt treatment. In our study, the most common Candida non-albicans species was *Candida tropicalis*. All *Candida* isolates were sensitive to Amphotericin B, so Amphotericin B can be used for empirical therapy in candidemia.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Sievert DM, Ricks P, Edwards JR, Schneider A, Patel J, Srinivasan A, et al. Antimicrobial-resistant pathogens associated with healthcare-associated infections: summary of data reported to the national healthcare safety network at the centers for disease control and prevention, 2009–2010. *Infect Control Hosp Epidemiol.* 2013;34(1):1–14.
2. Gupta N, Mittal N, Sood P, Kumar S, Kaur R, Mathur MD. Candidemia in neonatal intensive care unit. *Indian J Pathol Microbiol.* 2001;44(1):45–8.
3. Rajni E, Chaudhary P, Garg VK, Sharma R, Malik M. A complete clinico-epidemiological and microbiological profile of candidemia cases in a tertiary-care hospital in Western India. *Antimicrob Steward Healthc Epidemiol*. 2022;2(1):e37.
4. Bhattacharjee P. Epidemiology and antifungal susceptibility of Candida species in a tertiary care hospital, Kolkata, India. *Curr Med Mycol.* 2016;2(2):20–7.
5. Shivaprakasha S, Radhakrishnan K, Karim PM. Candida spp. other than Candida albicans: a major cause of fungaemia in a tertiary care centre. *Indian J Med Microbiol*. 2007;25(4):405–7.
6. Kett DH, Azoulay E, Echeverria PM, Vincent JL. Extended Prevalence of Infection in ICU Study (EPIC II) Group of Investigators Candida bloodstream infections in intensive care units: analysis of the extended prevalence of infection in intensive care unit study. *Crit Care Med*. 2011;39(4):665–70.
7. Shaik N, Penmetcha U, Myneni RB, Yarlagadda P, Singamsetty S. The study of identification and antifungal susceptibility pattern of candida species isolated from various clinical specimens in a tertiary care hospital, Chinakakani, Gyntur, AP, South India. *Int J Curr Microbiol Appl Sci.* 2016;5(7):71–91.
8. Xess I, Jain N, Hasan F, Mandal P, Banerjee U. Epidemiology of candidemia in a tertiary care centre of north India: 5-year study. *Infection.* 2007;35(4):256–9.
9. Kothari A, Sagar V. Epidemiology of Candida bloodstream infections in a tertiary care institute in India. *Indian J Med Microbiol*. 2009;27(2):171–2.
10. Khara R, Lakhani SJ, Vasava S. Isolation, identification and antifungal susceptibility testing of Candida species from sepsis patients from a rural based tertiary care and teaching hospital in Vadodara district, Gujarat. *Int Arch Integr Med.* 2017;4(7):151–60.
11. Sahni V, Agarwal SK, Singh NP, Anuradha S, Sikdar S, Wadhwa A, et al. Candidemia-an under-recognized nosocomial infection in Indian hospitals. *J Assoc Physicians India*. 2005;53:607–11.
12. Singh RI, Xess I, Mathur P, Behera B, Gupta B, Misra MC. Epidemiology of candidemia in critically ill trauma patients: experiences of a level I trauma center in North India. *J Med Microbiol.* 2011;60(Pt 3):342–8.
13. Rani R, Mohapatra NP, Mehta G, Randhawa VS. Changing trends of Candida species in neonatal septicemia in a tertiary north Indian hospital. *Indian J Med Microbiol.* 2002;20(1):42–4.
14. Giri S, Kindo AJ, Kalyani J. Candidemia in intensive care unit patients: a one-year study from a tertiary-care center in South India. *J Postgrad Med*. 2013;59:190–5.
15. Furnaleto MC, Rota JF, Quesada RM, Furnaleto-Maia L, Rodrigues R, Oda S, et al. Species distribution and in vitro fluconazole susceptibility of clinical Candida isolates in a Brazilian tertiary-care hospital over a 3-year period. *Rev Soc Bras Med Trop.* 2011;44(5):595–9.
16. Clinical and Laboratory Standards Institute (CLSI). Method for antifungal disk diffusion susceptibility testing of yeasts. 2nd ed. M44-A2. Wayne, PA: CLSI; 2009.
17. Verma AK, Prasad KN, Singh M, Dixit AK, Ayyagari A. Candidaemia in patients of a tertiary health care hospital from north India. *Indian J Med Res.* 2003;117:122–8.
18. Chowta MN, Adhikari P, Rajeev A, Shenoy AK. Study of risk factors and prevalence of invasive candidiasis in a tertiary-care hospital. *Indian J Crit Care Med.* 2007;11(2):67–73.

19. Bhatt M, Sarangi G, Paty BP, Mohapatra D, Chayani N, Mahapatra A, Das P, Sahoo D. Biofilm as a virulence marker in *Candida* species in nosocomial bloodstream infection and its correlation with antifungal resistance. *Indian J Med Microbiol.* 2015;33:112–4.

Cite this article: Bhalodia NM, Lakhani S, Bhalodia MJ, Javadekar T, Lakhani S. Changing trends in candidemia: A four-year prospective study at a rural tertiary care hospital. *Indian J Microbiol Res.* 2025;12(2):199–204.