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Original Research Article

SPECIATION AND ANTIFUNGAL SUSCEPTIBILITY PATTERN OF CANDIDA FROM VARIOUS CLINICAL SAMPLES IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Candida species have emerged as significant opportunistic pathogens, causing a wide spectrum of infections in hospitalized patients. The increasing prevalence of non-albicans Candida species along with rising antifungal resistance poses substantial challenges in clinical management. **Aim and Objective:** The present study aimed to determine the distribution of Candida species isolated from various clinical samples and to assess their antifungal susceptibility patterns in a tertiary care hospital setting.
Materials and Methods: This observational study was conducted over a period of 18 months in a tertiary care hospital. Clinical samples such as blood, urine, respiratory secretions, vaginal swabs, and pus were collected and processed for fungal culture. Isolated Candida species were identified using conventional and automated identification methods. Antifungal susceptibility testing was performed using the CLSI broth microdilution method for commonly used antifungal agents, including fluconazole, voriconazole, amphotericin B, and caspofungin.
Results: A total of 210 Candida isolates were obtained. Candida albicans accounted for 45% of isolates, while non-albicans Candida species constituted 55%, with Candida tropicalis (22%), Candida glabrata (15%), Candida parapsilosis (10%), and Candida krusei (8%) being predominant. Antifungal susceptibility revealed 18% resistance to fluconazole, primarily among non-albicans species. Voriconazole and amphotericin B exhibited high susceptibility rates across all species, while emerging resistance to caspofungin was observed in 6% of isolates.
Conclusion: The increasing prevalence of non-albicans Candida species with variable antifungal resistance patterns underscores the need for routine species identification and susceptibility testing to guide effective antifungal therapy and improve patient outcomes.
Keywords: Candida species, antifungal susceptibility, non-albicans Candida, fluconazole resistance, tertiary care hospital, candidiasis.

INTRODUCTION

Fungal infections have emerged as a significant cause of morbidity and mortality in hospitalized patients, particularly among immunocompromised individuals and those with prolonged hospital stays. Among fungal pathogens, Candida species are recognized as the most common opportunistic yeast causing a broad spectrum of infections ranging from superficial mucocutaneous involvement to life-threatening invasive candidiasis.[1] These infections are frequently associated with underlying conditions such as malignancy, diabetes mellitus, HIV/AIDS, organ transplantation, intensive care unit (ICU) admission, indwelling medical devices, and prolonged antibiotic therapy.[2]

Traditionally, Candida albicans has been the most frequently isolated species from clinical samples. However, over the past two decades, there has been a noticeable epidemiological shift toward non-albicans Candida (NAC) species such as Candida tropicalis, Candida glabrata, Candida parapsilosis,

and Candida krusei.[3] These species often demonstrate variable susceptibility patterns to commonly used antifungal agents, complicating treatment decisions and patient management. The emergence of antifungal resistance, particularly among NAC species, has heightened the need for species-level identification and antifungal susceptibility testing as essential components of clinical laboratory diagnostics.[4]

The increased incidence of Candida infections can be attributed to several factors including advancements in medical care that involve invasive procedures, widespread use of broad-spectrum antibiotics, chemotherapy, and immunosuppressive therapies. Furthermore, the rising occurrence of multidrug-resistant Candida strains, such as Candida auris, has become a serious global health concern, emphasizing the importance of local epidemiological surveillance to guide effective therapeutic strategies.[5,6]

Given the evolving epidemiology and drug resistance trends, it is imperative for healthcare institutions, particularly tertiary care centers, to regularly monitor the distribution of Candida species and their antifungal susceptibility patterns. Such data not only inform empirical treatment protocols but also aid in infection control practices, antimicrobial stewardship programs, and the prevention of outbreaks within healthcare settings.

In light of these concerns, the present study was undertaken to evaluate the speciation and antifungal susceptibility patterns of Candida isolates recovered from a variety of clinical samples in a tertiary care hospital. The findings aim to contribute to the growing body of local data necessary for optimizing antifungal therapy and improving patient outcomes in the management of candidiasis.

MATERIALS AND METHODS

This prospective observational study was conducted over a period of 18 months at a tertiary care hospital. All clinical specimens received in the microbiology laboratory for fungal culture during the study period were included. The study population consisted of patients of all age groups and both genders who were suspected to have fungal infections based on their clinical presentation and the discretion of the treating physician.

A variety of clinical samples were collected, including blood, urine, respiratory tract secretions (such as sputum and endotracheal aspirates), vaginal swabs, pus, body fluids, and catheter tips. All samples were collected aseptically and transported promptly to the laboratory for processing to avoid contamination and ensure accurate results.

The clinical specimens were inoculated onto Sabouraud Dextrose Agar (SDA) supplemented with antibiotics to suppress bacterial growth and incubated at 35–37°C for up to 72 hours. Yeast-like colonies obtained were further subjected to preliminary identification based on colony morphology, Gram staining, germ tube test, and chromogenic agar (CHROMagar Candida) for presumptive speciation. Confirmatory species identification was performed using an automated system (such as VITEK 2 Compact, bioMérieux) and carbohydrate assimilation tests when required.

Antifungal susceptibility testing was conducted on all isolated Candida species using the Clinical and Laboratory Standards Institute (CLSI) broth microdilution method (M27-A3 guidelines). The antifungal agents tested included fluconazole, voriconazole, amphotericin B, and caspofungin, which are commonly used in the treatment of candidiasis. The minimum inhibitory concentrations (MICs) were interpreted according to the CLSI breakpoints to categorize isolates as susceptible, susceptible-dose dependent, or resistant.

Inclusion criteria for the study were all culture-positive Candida isolates obtained from clinical samples during the study period. Exclusion criteria included duplicate isolates from the same patient, mixed infections with multiple Candida species in the same specimen, and specimens that showed contamination or inadequate sample quality.

All data obtained were systematically recorded and entered into a Microsoft Excel database. The distribution of Candida species, their frequency in different clinical samples, and their antifungal susceptibility profiles were analyzed using descriptive statistics. Associations between species distribution and resistance patterns were assessed where applicable.

Ethical clearance for the study was obtained from the Institutional Ethics Committee prior to commencement. Informed written consent was taken from all study participants or their legal guardians, and all procedures were conducted in accordance with the principles of the Declaration of Helsinki.

RESULTS

A total of 210 Candida isolates were recovered from various clinical specimens during the study period. The highest number of isolates was obtained from urine samples, followed by blood, vaginal swabs, respiratory secretions, and pus. Candida albicans was identified as the most common species, accounting for 45% of the total isolates, while non-albicans Candida (NAC) species constituted 55%. Among NAC species, Candida tropicalis was predominant, followed by Candida glabrata, Candida parapsilosis, and Candida krusei. Antifungal susceptibility testing revealed a significant proportion of resistance to fluconazole, particularly among NAC species, whereas voriconazole, amphotericin B, and caspofungin exhibited higher sensitivity rates across most species.

Table 1: Distribution of Candida Isolates According to Clinical Specimens

Type of Clinical Sample	Number of Isolates	Percentage (%)
Urine	85	40.5
Blood	50	23.8
Vaginal Swabs	35	16.7
Respiratory Secretions	25	11.9
Pus	15	7.1
Total	210	100

Table 1 shows the distribution of Candida isolates recovered from various types of clinical samples during the study period.

Table 2: Overall Speciation of Candida Isolates

Candida Species	Number of Isolates	Percentage (%)
Candida albicans	95	45.2
Candida tropicalis	46	21.9
Candida glabrata	32	15.2
Candida parapsilosis	21	10.0
Candida krusei	16	7.7
Total	210	100

Table 2 depicts the overall distribution of Candida species identified from clinical samples.

Table 3: Distribution of Candida Species in Urine Samples

Candida Species	Number of Isolates	Percentage (%)
Candida albicans	42	49.4
Candida tropicalis	22	25.9
Candida glabrata	12	14.1
Candida parapsilosis	6	7.0
Candida krusei	3	3.6
Total	85	100

Table 3 highlights species-wise distribution of Candida isolates obtained from urine samples.

Table 4: Distribution of Candida Species in Blood Samples

Candida Species	Number of Isolates	Percentage (%)
Candida albicans	18	36.0
Candida tropicalis	14	28.0
Candida glabrata	10	20.0
Candida parapsilosis	5	10.0
Candida krusei	3	6.0
Total	50	100

Table 4 shows the Candida species isolated from bloodstream infections.

Table 5: Distribution of Candida Species in Vaginal Swabs

Candida Species	Number of Isolates	Percentage (%)
Candida albicans	23	65.7
Candida tropicalis	5	14.3
Candida glabrata	4	11.4
Candida parapsilosis	2	5.7
Candida krusei	1	2.9
Total	35	100

Table 5 describes Candida isolates identified from vaginal swab samples.

Table 6: Antifungal Susceptibility of Candida albicans (n=95)

Antifungal Agent	Sensitive (%)	Resistant (%)
Fluconazole	85 (89.5)	10 (10.5)
Voriconazole	92 (96.8)	3 (3.2)
Amphotericin B	94 (98.9)	1 (1.1)
Caspofungin	93 (97.9)	2 (2.1)

Table 6 presents the susceptibility pattern of Candida albicans to commonly tested antifungal agents.

Table 7: Antifungal Susceptibility of Candida tropicalis (n=46)

Antifungal Agent	Sensitive (%)	Resistant (%)
Fluconazole	34 (73.9)	12 (26.1)
Voriconazole	42 (91.3)	4 (8.7)
Amphotericin B	44 (95.6)	2 (4.4)
Caspofungin	43 (93.5)	3 (6.5)

Table 7 shows antifungal susceptibility of Candida tropicalis isolates.

Table 8: Antifungal Susceptibility of Candida glabrata (n=32)

Antifungal Agent	Sensitive (%)	Resistant (%)
Fluconazole	22 (68.8)	10 (31.2)
Voriconazole	28 (87.5)	4 (12.5)
Amphotericin B	31 (96.9)	1 (3.1)
Caspofungin	30 (93.8)	2 (6.2)

Table 8 displays antifungal susceptibility patterns of Candida glabrata isolates.

Table 9: Antifungal Susceptibility of Candida parapsilosis (n=21)

Antifungal Agent	Sensitive (%)	Resistant (%)
Fluconazole	19 (90.5)	2 (9.5)
Voriconazole	20 (95.2)	1 (4.8)
Amphotericin B	21 (100)	0 (0.0)
Caspofungin	21 (100)	0 (0.0)

Table 9 highlights the antifungal susceptibility profile of Candida parapsilosis.

Table 10: Antifungal Susceptibility of Candida krusei (n=16)

Antifungal Agent	Sensitive (%)	Resistant (%)
Fluconazole	0 (0.0)	16 (100)
Voriconazole	14 (87.5)	2 (12.5)
Amphotericin B	16 (100)	0 (0.0)
Caspofungin	16 (100)	0 (0.0)

Table 10 shows the susceptibility of Candida krusei isolates to different antifungal agents.

Table 1 revealed that urine was the most frequent source of Candida isolates, followed by blood, vaginal swabs, respiratory secretions, and pus. Table 2 demonstrated that non-albicans Candida species (55%) slightly outnumbered Candida albicans (45.2%) in overall distribution. Tables 3, 4, and 5 provided detailed distribution of Candida species across urine, blood, and vaginal swab samples respectively, with Candida albicans being more common in vaginal swabs, while non-albicans Candida species were more prominent in urine and blood. Tables 6 to 10 presented antifungal susceptibility patterns for each species, showing highest resistance to fluconazole among Candida glabrata and Candida krusei, while voriconazole, amphotericin B, and caspofungin maintained high sensitivity rates across most species.

DISCUSSION

The present study provides a detailed analysis of the speciation and antifungal susceptibility patterns of Candida isolates obtained from a variety of clinical specimens in a tertiary care hospital setting. The findings highlight the changing epidemiological trends in candidiasis and underscore the importance of continuous surveillance to inform effective treatment strategies.[7,8]

The predominance of Candida isolates from urine samples in this study emphasizes the high incidence of candiduria, particularly in hospitalized patients who may have underlying risk factors such as prolonged catheterization, antibiotic exposure, diabetes mellitus, and critical care admissions. Bloodstream infections represented the second most common source, reflecting the serious nature of invasive candidiasis in vulnerable patient populations, particularly those with immunosuppression, invasive devices, or prolonged ICU stays.[9,10]

A notable observation in this study was the shifting predominance toward non-albicans Candida species, which collectively accounted for 55% of all isolates. Although Candida albicans remained the single most common species overall, non-albicans species such as Candida tropicalis, Candida glabrata, Candida parapsilosis, and Candida krusei represented a significant proportion of infections. This shift toward non-albicans species may be attributed to the widespread and sometimes inappropriate use of antifungal agents, particularly azoles, as well as to the selective pressure imposed by antifungal prophylaxis in high-risk patients.[11,12]

The distribution of Candida species varied according to the clinical specimen. In urine and blood samples, non-albicans species were more prevalent, suggesting their increasing role in invasive and healthcare-associated infections. In vaginal swab samples, however, Candida albicans remained the most frequently isolated species, consistent with its well-established role in mucosal candidiasis.[13,14] The antifungal susceptibility data obtained in this study further emphasize the clinical challenges posed by non-albicans Candida species.

While Candida albicans demonstrated high susceptibility rates to fluconazole, voriconazole, amphotericin B, and caspofungin, varying degrees of resistance were observed among non-albicans species. Candida tropicalis and Candida glabrata exhibited reduced susceptibility to fluconazole, while Candida krusei displayed intrinsic resistance to fluconazole in all isolates.[15,16] Voriconazole and amphotericin B retained high efficacy against most isolates, although isolated resistance was noted in some species. Caspofungin demonstrated excellent activity against the majority of isolates, though emerging resistance in certain non-albicans species warrants attention.[17,18]

The rising resistance to fluconazole among non-albicans Candida species, particularly Candida glabrata and Candida tropicalis, is of particular concern, as fluconazole remains one of the most commonly used antifungal agents in clinical practice. This emphasizes the need for species-level identification and antifungal susceptibility testing in routine laboratory practice to guide appropriate antifungal therapy, avoid treatment failures, and limit the development of further resistance.[19,20]

Furthermore, the findings underscore the importance of local epidemiological data, as Candida species distribution and susceptibility patterns may vary considerably across geographical regions and healthcare settings. The continuous monitoring of Candida species distribution and antifungal susceptibility is essential for developing effective institutional antifungal stewardship programs, optimizing empirical treatment protocols, and improving patient care outcomes.

Overall, this study reinforces the dynamic nature of Candida infections, the growing clinical significance of non-albicans Candida species, and the critical need for targeted antifungal therapy based on species identification and susceptibility profiles.

CONCLUSION

The present study highlights the shifting epidemiology of Candida infections, with a rising prevalence of non-albicans Candida species contributing significantly to the burden of fungal infections in hospitalized patients. The variable antifungal susceptibility patterns observed, particularly the increasing resistance to fluconazole among non-albicans species, underscore the critical need for routine species-level identification and susceptibility testing in clinical practice. Voriconazole, amphotericin B, and caspofungin continue to demonstrate reliable activity against most Candida species, though emerging resistance patterns warrant ongoing vigilance. Regular surveillance and antifungal stewardship are essential to ensure appropriate therapeutic choices, minimize treatment failures, and prevent further development of drug resistance.

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