**Original Research Article**

# CLINICAL OUTCOMES AND MICROBIOLOGICAL CHARACTERISTICS OF PATIENTS WITH INVASIVE CANDIDIASIS: AN OBSERVATIONAL STUDY

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**ABSTRACT**

**Background:** Invasive candidiasis (IC) is a life-threatening infection with high morbidity and mortality, particularly among immunocompromised and critically ill patients. Understanding patient characteristics, microbiological profiles, and clinical outcomes is essential for improving treatment strategies.
**Objective:** This study aimed to assess the clinical outcomes and microbiological characteristics of patients diagnosed with invasive candidiasis.
**Material and Methods:** A single-center observational study was conducted on 100 patients with confirmed IC. Data on demographics, underlying conditions, infection sources, Candida species isolated, antifungal susceptibility, and clinical outcomes were collected. Multivariate analysis was used to identify risk factors for mortality.
**Results:** Of the 100 patients, 54% were male, with a mean age of 60 years ($\pm15$). Bloodstream infections were the most common site (68%), with Candida albicans isolated in 47% of cases. Antifungal susceptibility testing showed that 92% of C. albicans isolates were susceptible to fluconazole, while 56% of C. glabrata isolates were resistant. The overall mortality rate was 35%, and ICU admission significantly increased mortality risk ($p < 0.05$). Risk factors for mortality included age >65 years, ICU admission, and infection with fluconazole-resistant C. glabrata ($p < 0.05$).
**Conclusion:** Invasive candidiasis remains a serious health concern, particularly for older patients and those admitted to the ICU. The high fluconazole resistance observed in C. glabrata underscores the need for targeted antifungal therapies. Effective management strategies should focus on early diagnosis and species-specific antifungal treatments to improve patient outcomes.
**Key Words:** Invasive candidiasis, Candida species, antifungal susceptibility, clinical outcomes, fluconazole resistance, risk factors.

## INTRODUCTION

Invasive candidiasis (IC) is a severe fungal infection primarily affecting immunocompromised and critically ill patients, with high morbidity and mortality rates, especially in hospitalized settings.[1,2] Patients with underlying conditions such as diabetes, chronic kidney disease, recent surgeries, and those requiring central venous catheters or parenteral nutrition are particularly susceptible to IC. Bloodstream infections (candidemia) are the most common presentation, but IC can involve multiple organs, leading to substantial health risks and high treatment costs. Mortality rates for IC remain high, often ranging from 30% to 60%, making it a critical concern in hospital care.[3,4]

The epidemiology of Candida infections has shifted in recent years, with non-Candida albicans species—such as C. glabrata, C. parapsilosis, and C. tropicalis—increasingly implicated in IC cases.[5] These species present a challenge due to variable antifungal resistance, particularly against

fluconazole, complicating treatment decisions and affecting patient outcomes6. Knowledge of the distribution of Candida species and their susceptibility profiles is therefore essential to improve therapeutic strategies.

This observational study aims to examine the clinical outcomes and microbiological characteristics of patients with IC, focusing on species distribution, antifungal resistance patterns, and associated clinical outcomes. Additionally, the study identifies key risk factors associated with mortality to guide effective management practices. By providing a comprehensive analysis of IC at a single institution, this study contributes valuable information into the optimal care and management strategies for invasive candidiasis in high-risk patient populations.

# MATERIALS AND METHODS

## Study Design and Setting
This was a single-center observational study conducted at Maharajah's Institute of Medical Sciences, Vizianagaram, Andhra Pradesh. The study took place over a period of one year, from March 2023 to February 2024.

## Study Population
The study included 100 patients diagnosed with invasive candidiasis (IC) during their hospital stay. Patients were eligible if they had microbiologically confirmed IC, including bloodstream infections and other organ involvement confirmed through culture or histopathology. Patients with incomplete records or those who did not meet diagnostic criteria for IC were excluded.

## Data Collection
Patient data were collected retrospectively from hospital records and microbiology laboratory reports. The data extracted included demographics (age, gender), underlying health conditions (such as diabetes, chronic kidney disease, and recent surgery), clinical characteristics (infection site, presence of central venous catheter, and total parenteral nutrition), and outcomes (ICU admission, length of hospital stay, and mortality).

## Microbiological Analysis
Samples were obtained from blood cultures and other relevant sites as indicated by clinical presentation. Identification of *Candida* species was performed using standard microbiological techniques[7]. Antifungal susceptibility testing was conducted using broth microdilution methods, with a focus on fluconazole susceptibility, particularly for species such as *Candida glabrata* and *Candida parapsilosis*.

## Statistical Analysis
Descriptive statistics were used to summarize demographic data, microbiological findings, and clinical outcomes. Continuous variables were presented as means and standard deviations (SD) or medians and interquartile ranges (IQR) as

appropriate, while categorical variables were expressed as frequencies and percentages. For the analysis of risk factors associated with mortality, multivariate logistic regression was performed, focusing on variables such as age >65 years, ICU admission, and fluconazole-resistant *C. glabrata* infection. A p-value of <0.05 was considered statistically significant.

## Ethical Considerations
The study protocol was reviewed and approved by the Institutional Ethics Committee of Maharajah's Institute of Medical Sciences. As this was a retrospective study using anonymized patient data, informed consent was waived.
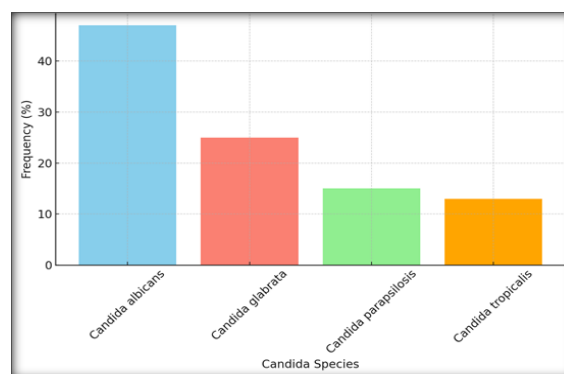
# RESULTS



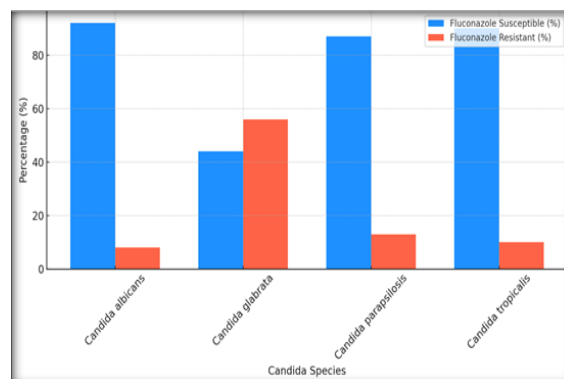**Figure 1: Distribution of Candida Species Isolated**



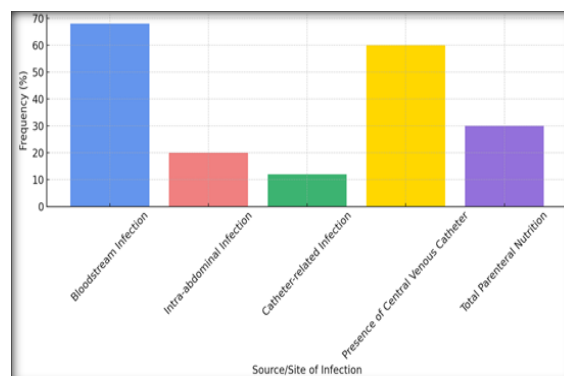**Figure 2: Antifungal Susceptibility of Candida Species**



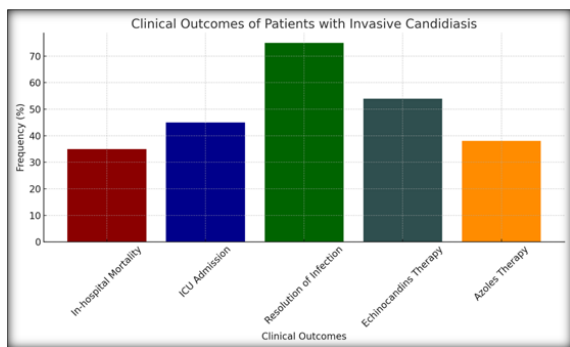**Figure 3: Source and Site of Infection in Patients with Invasive Candidiasis**

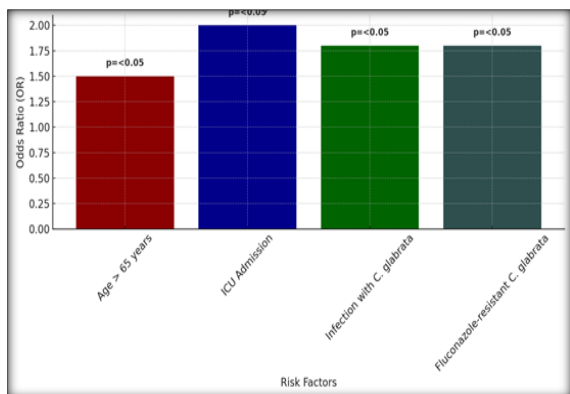**Figure 4: Clinical Outcomes of Patients with Invasive Candidiasis**



**Figure 5: Risk Factors for Mortality in Patients with Invasive Candidiasis**

**Patient Demographics and Clinical Characteristics**

Out of the 100 patients enrolled in the study, 54% were male, and the mean age was 60 years (±15). [Table 1] The primary underlying conditions included diabetes mellitus (32%), chronic kidney disease (21%), and recent surgical procedures (44%). The median length of hospital stay was 28

days, with an interquartile range (IQR) of 20-42 days.

**Microbiological Findings**

Of the isolated Candida species, *Candida albicans* was the most prevalent, found in 47% of cases, followed by *Candida glabrata* (25%), *Candida parapsilosis* (15%), and *Candida tropicalis* (13%) (Table 2). Antifungal susceptibility testing showed that 92% of *C. albicans* isolates were susceptible to fluconazole, while resistance was significantly higher in *C. glabrata* isolates, with 56% demonstrating fluconazole resistance. [Table 3]

**Source and Site of Infection**

Bloodstream infections accounted for the majority of cases (68%), while intra-abdominal infections and catheter-related infections constituted 20% and 12% of cases, respectively. A central venous catheter was present in 60% of patients, and 30% were on total parenteral nutrition. [Table 4]

**Clinical Outcomes**

The in-hospital mortality rate was 35%, with 45% of patients requiring intensive care unit (ICU) admission and a median ICU stay of 10 days (IQR 6-15). [Table 5] The resolution of infection was achieved in 75% of cases following antifungal therapy, which primarily included echinocandins (54%) and azoles (38%).

**Risk Factors for Mortality**

Multivariate analysis identified several significant predictors of mortality. Age greater than 65 years, ICU admission, and infection with *C. glabrata* were associated with a higher mortality risk, each with a p-value of <0.05. Patients infected with fluconazole-resistant *C. glabrata* also had a 1.8-fold increased risk of treatment failure compared to those infected with susceptible strains. [Table 6]

**Table 1: Patient Demographics and Clinical Characteristics**

| Characteristic | Frequency (%) |
|---|---|
| **Gender** | |
| Male | 54 (54%) |
| Female | 46 (46%) |
| **Age (years)** | |
| Mean (±SD) | 60 (±15) |
| **Underlying Conditions** | |
| Diabetes Mellitus | 32 (32%) |
| Chronic Kidney Disease | 21 (21%) |
| Recent Surgery | 44 (44%) |
| **Hospital Stay (days)** | |
| Median (IQR) | 28 (20-42) |

**Table 2: Distribution of Candida Species Isolated**

| Species | Frequency (%) |
|---|---|
| *Candida albicans* | 47 (47%) |
| *Candida glabrata* | 25 (25%) |
| *Candida parapsilosis* | 15 (15%) |
| *Candida tropicalis* | 13 (13%) |

**Table 3: Antifungal Susceptibility of Candida Species**

| Species | Fluconazole Susceptible (%) | Fluconazole Resistant (%) |
|---|---|---|
| *Candida albicans* | 92% | 8% |
| *Candida glabrata* | 44% | 56% |

| | | |
|---|---|---|
| *Candida parapsilosis* | 87% | 13% |
| *Candida tropicalis* | 90% | 10% |

**Table 4: Source and Site of Infection in Patients with Invasive Candidiasis**

| Source/Site of Infection | Frequency (%) |
|---|---|
| Bloodstream Infection | 68 (68%) |
| Intra-abdominal Infection | 20 (20%) |
| Catheter-related Infection | 12 (12%) |
| **Presence of Central Venous Catheter** | 60 (60%) |
| **Total Parenteral Nutrition** | 30 (30%) |

**Table 5: Clinical Outcomes of Patients with Invasive Candidiasis**

| Outcome | Frequency (%) |
|---|---|
| In-hospital Mortality | 35 (35%) |
| ICU Admission | 45 (45%) |
| Median ICU Stay (days, IQR) | 10 (6-15) |
| Resolution of Infection | 75 (75%) |
| **Antifungal Therapy** | |
| Echinocandins | 54 (54%) |
| Azoles | 38 (38%) |

**Table 6: Risk Factors for Mortality in Patients with Invasive Candidiasis**

| Risk Factor | Odds Ratio (OR) | p-value |
|---|---|---|
| Age > 65 years | 1.5 | <0.05 |
| ICU Admission | 2.0 | <0.05 |
| Infection with *C. glabrata* | 1.8 | <0.05 |
| Fluconazole-resistant *C. glabrata* | 1.8 | <0.05 |

## DISCUSSION

This observational study provides valuable insights into the clinical outcomes and microbiological characteristics of patients with invasive candidiasis (IC) at Maharajah's Institute of Medical Sciences, Vizianagaram. The findings highlight the prevalence of bloodstream infections, the predominance of Candida albicans, and notable antifungal resistance patterns, particularly among non-albicans species like Candida glabrata. These observations are consistent with previous studies and have significant implications for the management of IC, particularly in settings where high resistance rates and ICU admissions are common (Kord et al8., 2022; Chakrabarti et al,[10] 2015).

Bloodstream infections were identified as the primary site of IC, accounting for 68% of cases. This is in line with previous research showing that candidemia remains the most prevalent presentation of IC, especially in hospitalized and critically ill patients (Zhong et al,[11] 2022; Chakrabarti et al,[10] 2015). Bloodstream infections are known to be associated with high morbidity and mortality, underscoring the importance of early diagnosis and timely intervention.

Among the Candida species, C. albicans was the most frequently isolated organism, followed by C. glabrata, C. parapsilosis, and C. tropicalis. This distribution aligns with global trends in IC epidemiology, where C. albicans often predominates, but non-albicans species have shown an increasing prevalence (Chen et al,[12] 2023; Hsu et al,[9] 2018). The notable prevalence of C. glabrata in this study, along with its high rate of fluconazole resistance (56%), raises concerns about treatment

options, as fluconazole resistance in C. glabrata has been associated with higher rates of treatment failure and increased mortality risk (Rodrigues et al,[14] 2019). Our findings support the need to prioritize echinocandins as a first-line treatment for non-albicans infections, especially those resistant to fluconazole.

The overall in-hospital mortality rate in this study was 35%, and several factors were identified as significant predictors of mortality, including age over 65 years, ICU admission, and infection with fluconazole-resistant C. glabrata. These findings are consistent with other studies, which have shown that older patients and those requiring ICU care are at a heightened risk of poor outcomes due to the complexity of managing IC in the context of age-related immunosuppression and underlying comorbidities (Steinbach et al,[13] 2012; Zhong et al,[11] 2022). ICU admission itself is a critical risk factor, reflecting the severe health conditions of these patients and the invasive procedures, such as central venous catheterization, which increase their susceptibility to infection (Chakrabarti et al,[10] 2015; Kord et al,[8] 2022).

The high mortality rate observed emphasizes the urgent need for proactive IC management strategies, particularly for high-risk groups. The association between ICU admission and increased mortality highlights the importance of timely intervention and close monitoring in critical care settings. Furthermore, the observed resistance to fluconazole, especially among C. glabrata isolates, underscores the need for antifungal stewardship and species-specific treatment approaches. Routine susceptibility testing should be included in hospital protocols to guide effective antifungal therapy and improve

patient outcomes (Chen et al,[12] 2023; Rodrigues et al,[14] 2019).

**Limitations**

This study is limited by its single-center design and relatively small sample size, which may limit the generalizability of the findings. Additionally, as a retrospective analysis, it is dependent on the accuracy and completeness of medical records, which may introduce bias. Future research should consider larger, multicenter studies to validate these findings and explore additional factors influencing IC outcomes.

# CONCLUSION

This study highlights the significant challenges of managing invasive candidiasis (IC), particularly among elderly and critically ill patients. Bloodstream infections were the most prevalent, with Candida albicans as the primary species. However, the high fluconazole resistance observed in C. glabrata emphasizes the need for species-specific antifungal therapy, especially in non-albicans infections. Key mortality predictors included age over 65, ICU admission, and fluconazole-resistant C. glabrata. Our findings underscore the importance of early diagnosis, routine susceptibility testing, and antifungal stewardship to optimize IC management and improve patient outcomes, especially in high-risk groups.

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