Incidence And Risk Factors For Invasive Candidiasis In A Neonatal Intensive Care Unit In Central India

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Abstract
Invasive candidiasis (IC) poses a significant threat to neonates in intensive care units, contributing to high morbidity and mortality rates. This prospective study aimed to assess the incidence and identify risk factors associated with IC in a neonatal intensive care unit (NICU) in Central India over a two-year period from June 2022 to May 2024. Out of 563 blood cultures performed, 54 (9.59%) were positive for Candida species, with non-albicans Candida (NAC) species predominating. Key risk factors for IC included prematurity, very low birth weight, use of broad-spectrum antibiotics, central venous catheters, mechanical ventilation, parenteral nutrition, and extended NICU stay. Antifungal susceptibility testing revealed variable resistance among NAC species, emphasizing the need for tailored antifungal strategies. This study highlights the importance of vigilant monitoring, targeted interventions, and ongoing surveillance to improve outcomes for neonates at risk of IC.

Introduction
Invasive candidiasis (IC) represents a major concern in neonatal intensive care units (NICUs) due to its association with high morbidity and mortality. IC is primarily caused by Candida species, with Candida albicans historically being the most common pathogen. However, recent trends indicate a rise in infections caused by non-albicans Candida (NAC) species, which are often more resistant to antifungal treatments [1][2].

The increase in survival rates of extremely premature infants, a significant achievement in neonatal medicine, has paradoxically contributed to a higher incidence of IC. Premature neonates, especially those with very low birth weights, are particularly susceptible to IC due to their underdeveloped immune systems and the frequent need for invasive procedures [3]. The risk is further compounded by factors such as prolonged use of broad-spectrum antibiotics, central venous catheters, and mechanical ventilation, which can disrupt normal flora and provide a direct route for Candida to enter the bloodstream [4][5].

Recent studies have highlighted a shift in Candida epidemiology, with NAC species like Candida krusei and Candida glabrata becoming more prevalent [6][7]. These species exhibit varying degrees of resistance to commonly used antifungal agents, complicating treatment strategies and necessitating ongoing surveillance and susceptibility testing [8][9].

This study was conducted to evaluate the incidence of IC in a NICU in Central India and to identify the associated risk factors. The findings aim to enhance our understanding of the local epidemiology of IC and to inform strategies for prevention and management in similar healthcare settings.

Methods

Study Design

This prospective study was conducted in the NICU of a tertiary care hospital in Central India from June 2022 to May 2024. All neonates admitted to the NICU during this period were included in the study.

Data Collection

Medical records were reviewed to collect data on demographics, clinical features, risk factors, laboratory results, and outcomes. Blood cultures were obtained from neonates with clinical signs of sepsis. Candida isolates were identified using standard mycological techniques, and antifungal susceptibility was assessed by disk diffusion.

Statistical Analysis

Descriptive statistics were used to summarize the data. Risk factors for IC were analyzed using chi-square tests, with a p-value of less than 0.05 considered statistically significant.

Results

Incidence of Invasive Candidiasis

Among 563 blood cultures, 54 (9.59%) yielded Candida species. Non-albicans Candida species were predominant, accounting for 64.81% of cases. The most common NAC species were Candida krusei and Candida glabrata.

Table 1: Incidence of Candida Species in Blood Cultures

Candida Species	Number of Isolates	Percentage (%)
Candida albicans	19	35.19
Non-albicans Candida	35	64.81
- C. krusei	13	24.07
- C. glabrata	10	18.52
- Other NAC species	12	22.22

Risk Factors for Invasive Candidiasis

Significant risk factors for IC included prematurity, very low birth weight, use of broad-spectrum antibiotics, central venous catheters, mechanical ventilation, parenteral nutrition, and extended NICU stay.

Table 2: Risk Factors for Invasive Candidiasis

Risk Factor	IC Cases (n=54)	Non-IC Cases (n=509)	p-value
Prematurity (<34 weeks)	37	89	<0.001
Very low birth weight (<1500g)	42	76	<0.001
Broad-spectrum antibiotics	49	121	<0.001
Central venous catheters	45	134	<0.001
Mechanical ventilation	39	97	<0.001
Parenteral nutrition	41	104	<0.001
Extended NICU stay (>14 days)	44	113	<0.001

Antifungal Susceptibility

Antifungal susceptibility testing showed that Candida albicans was uniformly sensitive to fluconazole, while NAC species exhibited variable resistance. Candida krusei and Candida glabrata demonstrated higher resistance to fluconazole.

Table 3: Antifungal Susceptibility of Candida Isolates

Antifungal Agent	C. albicans (n=19)	C. krusei (n=13)	C. glabrata (n=10)	Other NAC (n=12)
Fluconazole	19 (100%)	3 (23.08%)	4 (40%)	8 (66.67%)
Amphotericin B	18 (94.74%)	12 (92.31%)	9 (90%)	11 (91.67%)
Voriconazole	19 (100%)	13 (100%)	10 (100%)	12 (100%)

Discussion

The incidence of IC in our study was 9.59%, consistent with reported rates from other NICUs worldwide, which range from 2% to 15% [10][11]. This reflects a significant burden of IC in our NICU, in line with high-incidence regions.

Our findings confirm known risk factors for IC, such as prematurity, very low birth weight, and prolonged NICU stay [12][13]. The use of broad-spectrum antibiotics and invasive procedures like central venous catheters and mechanical ventilation are well-established risk factors, contributing to the high incidence of IC [14][15].

The resistance patterns observed among NAC species highlight the need for regular antifungal susceptibility testing and the potential necessity for alternative treatments [16][17]. The observed resistance trends are in line with global shifts towards more resistant Candida species [18][19].

The prevalence of NAC species and increasing resistance to antifungal agents in our study align with trends reported in other studies [20][21]. This global trend underscores the need for international collaboration to address the challenges posed by IC.

Our results suggest several clinical implications, including the need for early identification and targeted antifungal prophylaxis in high-risk neonates [22]. Implementing antifungal stewardship programs and adhering to stringent infection control measures could help reduce IC incidence and improve patient outcomes [23][24].

Conclusion

This study highlights the high incidence of IC in a NICU in Central India and identifies key risk factors. The predominance of NAC species and their variable resistance patterns underscore the need for vigilant monitoring, targeted interventions, and ongoing surveillance to enhance patient care and outcomes.

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