Detection of Candidemia in a Sample of Iraqi Neonates Admitted to the Neonates' Intensive Care Unit (NICU) by Conventional Methods

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Abstract

Background	There are many cases of neonatal intensive care unit (NICU) admission due to sepsis; many of them have bacterial sepsis, and others have a serious health risk from fungemia, particularly infections brought on by fungal infection. Numerous variables, including gestational age, birth weight, and the use of invasive medical procedures, might affect the incidence of fungemia. It is important to know how often fungemia happens in NICUs and what the risk factors are in order to improving infection control strategies and come up with effective strategies to prevent infections.
Objective	To determine the prevalence of fungal infection in newborns who had risk factors by using conventional diagnostic techniques.
Methods	This study included 100 newborns who were admitted into NICUs in Children Welfare Teaching Hospital and Baghdad Teaching Hospital at the period from December 2022 to the end of April 2023. They were having one or more of these risk factors; history of invasive procedures, antibiotic usage, and hospital care management techniques. Conventional blood culture procedure.
Results	The findings showed that none of the newborns who were recruited had any evidence of candidemia, which was unexpected considering the known risk factors and the well-acknowledged sensitivity of these diagnostic techniques.
Conclusion	Traditional diagnostic methods in neonatal candidemia detection may lack sensitivity, highlighting the potential for molecular techniques like polymerase chain reaction (PCR), though further research is warranted due to study limitations.
Keywords	Candidemia, Conventional Methods, Neonatal Intensive Care Unit (NICU), Risk Factors and Efficacy
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List of abbreviations: NICU = Neonatal intensive care unit, PCR = Polymerase chain reaction, Spp. = Species

Introduction

Newborns are at high risk of candidemia, it caused by Candida species, especially those found in neonatal intensive care units (NICUs). For newborns admitted into hospitals, it is a major cause of morbidity and mortality, especially for those with certain risk factors [1]. For successful treatment and better results, candidemia must be identified early and accurately [2]. Identification of candidemia in newborns remains difficult, despite advances in medical technology, and often leads to delays in the diagnosis and treatment [3]. Because newborns in NICUs systematically undergo surgeries and have underdeveloped

immune systems, they are more susceptible to infections [4]. Given that the clinical symptoms of candidemia in this group are often non-specific and misdiagnosed as other conditions, the diagnosis of candidemia is challenging [5].

Although Gram stain and culture in BacT/ALERT tubes are common diagnostic techniques, their effectiveness in newborns has not been well studied [6]. It is important to know how these approaches work in the high-risk neonatal setting, especially in light of the potentially serious consequences of undiagnosed candidemia.

The marked underdiagnosis of candidiasis in at-risk newborns, even with the use of conventional diagnostic methods, was a driving force for this investigation. In the case of the NICU, this discrepancy calls into question the sensitivity and specificity of these techniques [8]. To ensure the reliability of these diagnostic procedures and identify any deficiencies in state-of-the-art clinical practice, a comprehensive evaluation is essential [9].

The aim of this study was to provide a comprehensive examination of these traditional techniques in the NICU setting and to provide insight into their effectiveness.

Methods
Study design
The efficiency of conventional diagnostic methods in detecting Candida in newborns admitted into NICU and risk factors for infection was investigated in this cross-sectional study. Five months were allotted to the study, which began in December 2022 and ended at the end of April 2023. One hundred newborns (67 males and 33 females) who were identified as having risk signs of Candida infection at the time of admission to the NICUs at the Baghdad Teaching Hospital and the Children's Welfare Teaching Hospital were selected to participate in the research.

Study setting and population
Neonates identified as having risk markers for candidemia at the time of their NICU admission were selected to participate in this study. Neonates who met one or more of the following criteria were eligible for participation low birth weight, preterm, use of invasive procedures, delay in enteral feeding of more than three days, hazards associated with antibiotics, hospitalization lasting more than seven days, and thrombocytopenia. Neonates who lacked any risk factors or had been treated with antifungal medications were not involved in this study.

Data collection and sampling
The left-over blood of the 100 neonates who involved in the study was introduced into a BacT/ALERT culture bottle, which is an automated technique used for the identification of microbial proliferation. The aforementioned technique was widely regarded as a benchmark in the field of investigation and was used to validate the existence of Candida species. The sample was thereafter placed in the BacT/ALERT 3D Microbial Identification System, manufactured by Biomerieux, and incubated for a duration of five days at a temperature of 27°C. The study used aseptic techniques to collect 1 ml of venous blood, using established methods to reduce the potential for contamination.

Subsequently, the blood samples were expeditiously subjected to examination Gram stain and microscopy techniques.

The Gram stain technique involves the application of certain stains to blood samples in order to discern and distinguish between bacterial and fungal microorganisms. The stained specimens were subjected to microscopic analysis in order to detect any fungal components that may indicate the presence of Candida spp.

Results
Demographic and clinical characteristics
Sex distribution
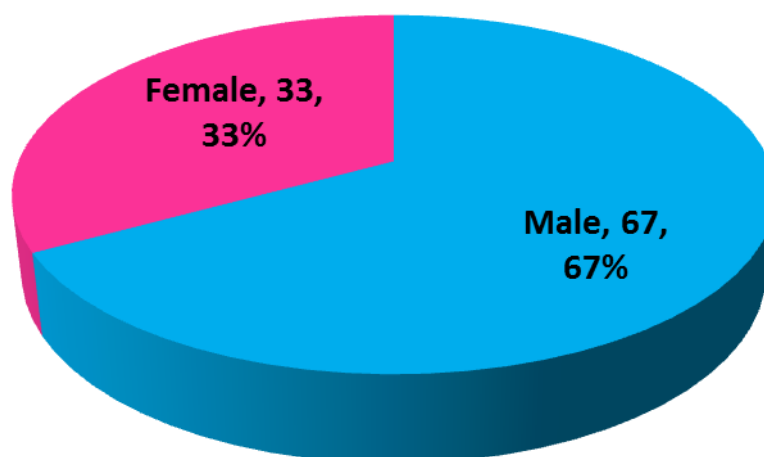Sixty seven percent were male, and thirty three percent were female (Figure 1).

Figure 1. Sex distribution of neonates in NICU

Gestational age

The mean gestational age was 32 weeks, with a range from 26 to 36 weeks. Figure (2) shows the classification of neonates admitted to NICU regarding gestational age groups, majority of them were term (43%), while the least percentage for those who were extremely preterm (3%).
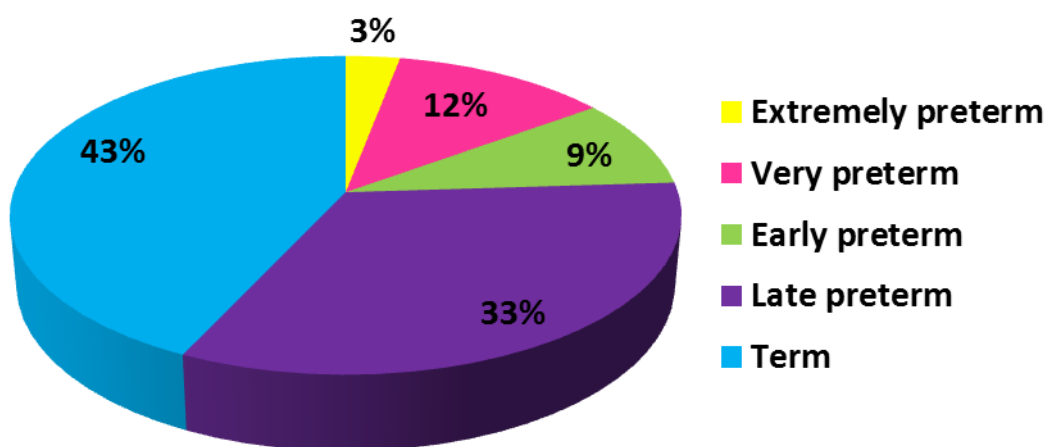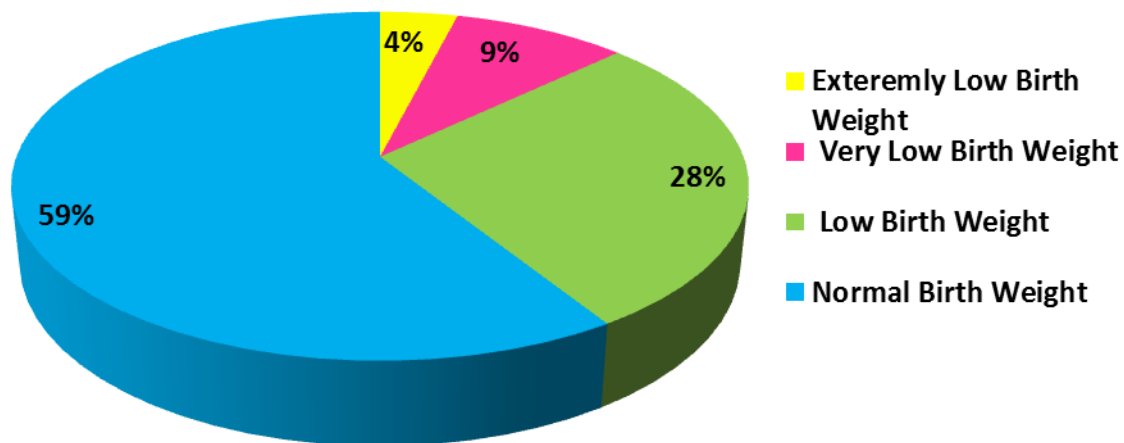

Figure 2. Classification of neonates admitted to NICU regarding gestational age groups

Birth weight

The average birth weight was 2,500 g, ranging from 700 grams to 400 grams. Figure (3) shows classification of neonates admitted to the NICU regarding birth weight groups, majority of them were with normal birth weight (59%) and the least percentage were those with extremely low birth weight (4%).

Risk factors

The most common risk factors included receipt of broad-spectrum antibiotics (90%), prematurity (57%), prolonged NICU stay (over 7 days) (51%), and use of an endotracheal tube (44%).

Figure 3. Classification of neonates admitted to the NICU regarding birth weight groups

Clinical symptoms

The majority of the neonates exhibited non-specific symptoms such as fever (60%), respiratory distress (45%), and feeding intolerance (40%).

Diagnostic test results

The results of the study indicate that there was no development of Candida species in the cultures conducted with BacT/ALERT tubes across all 100 instances. Microscopic analysis revealed the absence of fungal cells in all of the examined samples. The Gram stain technique was used to examine 100 samples, and it was found that none of them had any fungal infection.

Sensitivity and specificity analysis

As candidemia cases were not identified in the research, it was not possible to determine the sensitivity of Gram stain and culture in BacT/ALERT tubes. In the present context, the level of specificity is regarded as 100% on the assumption that there are no occurrences of false-positive outcomes.

Comparative analysis

After a comparative analysis of the two diagnostic techniques, no significant differences in their performance were found. The lack of recognition of this specific group of newborns raises questions about the efficiency and accuracy of these techniques.

Discussion

The results of this study suggest that recent diagnostic methods may not be sensitive enough to detect candidemia in newborns in NICU who have risk factors. This finding highlights a potential shortcoming in the diagnostic capabilities of these techniques and calls for a comprehensive reevaluation of current treatment strategies in the treatment of suspected fungal infections in this vulnerable population [4,5]. The amount of blood (1 ml) obtained was insufficient to determine low levels of fungal presence. The standard diagnostic techniques that were used in this investigation may have limitations, especially when it comes to their sensitivity when used in blood samples from newborns.

Despite constituted risk factors such as immaturity and prolonged antibiotic use, no candidemia was identified in the entire group of 100 neonates. This is in stark contrast to the current understanding of the prevalence of this infection and associated risks in NICU environments [1,6].

The observed disparity might perhaps be ascribed to the inherent constraints of the methodologies used. The Gram stain and microscopy techniques have been shown to have some limits in terms of sensitivity, especially when dealing with samples that have a low fungal load [7,8]. Furthermore, it should be noted that the conventional blood culture

technique, while widely regarded as the most reliable approach, may exhibit reduced efficacy when used to neonates owing to the limited quantity of blood that can be generally obtained from this specific demographic [8,9].

The use of traditional diagnostic procedures in the research prompts inquiries about their sufficiency in neonatal environments. Contemporary molecular techniques, such as polymerase chain reaction (PCR), have the potential to enhance the sensitivity and specificity of candidemia and other fungal infection detection in neonates [10]. However, it is important to note that the methodologies mentioned in the previous statement were not included in the scope of this study, thus indicating a potential avenue for further investigation.

One of the limitations of this research is the restricted sample size, which only focuses on neonates with identified risk factors [9]. The generalizability of the results to all neonatal groups or NICU settings may be limited [1].

In conclusion, conventional methods may be considered insensitive for the detection of fungemia in neonates, or in those patients difficult to obtain enough blood samples from there.

Author contribution
Nasif: Msc student, collection of data, writing the manuscript draft. Dr. Al-Attraqchi and Mohammed supervised the work, edit and finalize the writing of the study.

Conflict of interest
The author declares that they have no competing interests.

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