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Original research article

Evaluation of blood culture to find out proportion of bacterial infection among suspected cases of pneumonia, sepsis and meningitis in under-five children

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Abstract

This study focuses on the systematic evaluation of blood culture as a diagnostic tool to determine the proportion of bacterial infections in under-five children suspected of having pneumonia, sepsis, or meningitis. Understanding the prevalence and types of bacterial agents responsible for these infections is crucial for guiding treatment strategies, formulating public health policies, and ultimately reducing the burden of severe bacterial diseases in the pediatric population. The findings of this evaluation will contribute valuable insights to enhance the clinical management and preventive measures targeting bacterial infections in young children, thereby improving overall child health outcomes.

Keywords: Under-five children, pneumonia, sepsis, meningitis, blood culture, bacterial infection, microbiology, tertiary care hospital, automated blood culture system, antibiotic resistance

Introduction

The probability of death of a child born in a specific year or period before completing 5 years of age is known as under 5 mortality rate. It is measured in terms of how many children out of every 1000 live births died before they turn five [1]. The clinical appearance of Sepsis is variable and non-specific, and it affects a wide range of people. Sepsis is a dynamic disease with a complex pathogenesis. In a nutshell, for a child to be Septic, the infection must be spread to different organs through hematogenous route. Diagnosis of end organ system involvement in severe Sepsis is necessary. With an estimated 7.5 million deaths each year, Sepsis is the greatest cause of death in children globally. It includes the top four factors listed by the WHO as contributing to child mortality [5].

Bacterial infections are significant contributors to morbidity and mortality, particularly among under-five children, where their immune systems are still developing [3]. Pneumonia, sepsis, and meningitis are critical conditions that can lead to severe health outcomes if not promptly diagnosed and treated. The evaluation of blood culture is a crucial diagnostic approach to identify and understand the proportion of bacterial infections in under-five children presenting with symptoms of these life-threatening illnesses [4].

The study, conducted in the Department of Microbiology of a tertiary care hospital in Madhya Pradesh aimed to evaluate the proportion of bacterial infections among under-five children suspected of pneumonia, sepsis, and meningitis over a one-year period from August 2021 to July 2022, included under-five children presenting symptoms indicative of pneumonia, sepsis, or meningitis. Ethical approval was obtained, and written consent was collected from parents. Blood samples were collected using the BacT/ALERT 3D automated blood culture system, and bacterial identification was performed through standard microbiological techniques.

AIM: the aim of this study was to evaluate the proportion of bacterial infection among children of under-five year age group suspected of pneumonia, sepsis and meningitis.

Material and Methods

Study area and Study period: Study was conducted in the Department of Microbiology of a tertiary care hospital over a period of 1 year from August 2021 to July 2022

Study design: This was a Hospital based cross-sectional study.

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Study population: Under-five children who were suspected for pneumonia, sepsis and meningitis.

Ethical consideration: Study was approved by the Institutional Ethics committee. A written consent from parents of all eligible patients was collected before enrolling the patient in the study.

Procedure

Blood sample collection and Identification of bacteria: Blood samples from suspected cases were collected in a culture bottle of automated blood culture system BacT/ALERT 3D after taking written consent. The culture bottles were incubated in BacT/ALERT 3D system at 37 °C aerobically. The samples with no growth on the seventh day were considered negative The blood cultures which gave positive growth were Gram's stained and inoculated in 5% sheep blood agar, Chocolate Agar plate and MacConkey Agar and was incubated aerobically at 37 °C for 24-48 hrs for bacterial isolation and identification.

Isolation and identification of bacteria: After overnight incubation of the inoculum all culture media plates were examined for growth of colonies. All culture media plate showing colony growth were examined, Gram's stained and identified and characterized on the basis of morphology, cultural characteristics, and standard biochemical testing. Gram positive and Gram negative organisms were identified by a series of biochemical tests like catalase test, coagulase test, Triple Sugar Iron slant agar (TSI), indole test and urease test (Oxoid) and Simmons Citrate test.

Results and discussion

A total of 63 Blood samples were received during the study period processed for isolation and identification of Bacteria. In this study the majority of subjects were infants (80%) with mean age of 11.64 ±15.03 months. Jayaraman *et al*. in a meta-analysis showed 2.98% under age of 5 yrs children were hospitalized with suspected invasive sepsis. In the present study, fever (90.7%) was the most common manifestation followed by seizure (47.9%), altered sensorium (40%) and refusal to feed (37.9%) [1]. (Table 1).

In the present study, antibiotic usage prior to admission was reported in 57.1% cases while 21.4% did not use any antibiotics and in 21.4% cases, no records were present. (Table-2) In the present study, those with positive antibiotic history, the majority (83.8%) of samples were sterile and culture growth was seen in 16.2% cases. In those with negative or unknown antibiotic history, about 70% were found sterile while 30% were culture positive. Inclusion of cases known to have been managed with antibiotics probably reduced the number of cultures with positive results. Most patients admitted in tertiary care centers received antibiotics over the counter as community antibiotic use is very prevalent in India.

In our study about 77.9% of samples were sterile. *CONS* (11%), *K. pneumoniae* (9.5%), *S. aureus* (9.5%). *Pseudomonas* (4%), *E. coli* {3%) and *Acinetobacter* (196) were identified. Reyhan reported 70.53% cases sterile and CONS was the most frequent organism (45.9%) isolated in their study [2]. (Table 3-4).

We found bacterial growth 39.68% of culture processed whereas Reyhan reported the rate of growth to be 29.47. In our study, the rate of growth was found to be 20.63% for Gram positive bacteria and 19.04% for Gram negative bacteria. In a study from Inönü University, the rate of gram positive bacteria was reported to be 68.5% and the rate of gram negative bacteria was reported to be 3.5% whereas Reyhan reported 65.06% isolation of Gram positive bacteria and 30.36% for Gram negative bacteria [2].

Conclusion

Pneumonia, characterized by inflammation of the lungs, remains a leading cause of illness and death in young children worldwide. Similarly, sepsis, a systemic response to infection, and meningitis, an inflammation of the membranes surrounding the brain and spinal cord, pose substantial health risks in this vulnerable age group. Prompt and accurate identification of bacterial pathogens causing these infections is essential for tailored and effective therapeutic interventions. In conclusion, this study provides valuable insights into the prevalence of bacterial infections among under-five children presenting with symptoms of pneumonia, sepsis, and meningitis. The high rate of sterile samples and the spectrum of identified bacteria underscore the complexities of bacterial etiology in these conditions, emphasizing the need for further research and tailored management strategies.

Table 1: Distribution of cases according to Clinical Features

Clinical Features	Percentage (%)
Fever	90.70%
Seizure	47.90%
Altered Sensorium	40.00%
Refusal to feed	37.90%
Vomiting	28.60%
Meningeal signs	15.00%

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Cough	37.90%
Tachypnea	45.00%
Chest lndrawng	39.30%
Severe Respiratory Distress	42.90%
Hypoxia	46.40%
Lethargy	60.00%

Table 2: Case distribution according to antibiotic administration history

History of Prior Antibiotic Administration	Percentage
Given	57.10%
Not Given	21.40%
Not Known	21.40%

Table 3: Distribution of isolates grown in total culture processed on basis of gram staining (n=63)

Isolates grown	Number	Percentage %
Gram Positive Organism	13	20.63
Gram Negative Organism	12	19.04
Total	25	39.68

Table 4: Distribution of isolates grown in culture (n-63)

Isolates grown	Number	Percentage %
Acinetobacter	1	1.6
Coagulase Negative Staphylococcus	7	11
E.coli	2	3.2
K.pneuimoniae	6	9.52
Staphylococcus aureus	6	9.52
Pseudomonas species	3	4.7
Sterile	38	60.46
	25	100

Table 5: Distribution of Isolates grown in CSF on basis of antibiotic consumption history

Isolates	Antibiotics history						Total
	Given		Not Given		Not Known		
	Number	Percentage (%)	Number	Percentage (%)	Number	Percentage (%)	
Acinetobacter	0	0	1	12.5	0	0	1
Coagulase Negative Staphylococcus	0	0	3	37.5	4	66.67	7
E. coli	0	0	1	12.5	1	16.67	2
K. pneumoniae	3	27.27	2	25	1	16.67	6
Staphylococcus aureus	5	45.45	1	12.5	0	0	6
Pseudomonas species	3	27.27	0	0	0	0	3
Total	11	100	8	100	6	100	25

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