

Assessment of Bacteraemia/Septicaemia in Paediatric Patients in a Tertiary Care Hospital

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Abstract

Background: Septicaemia is a common cause of morbidity and mortality in neonates and children. The detection of microorganisms in a patient's blood has a great diagnostic and prognostic significance. Blood culture remains the gold standard for the diagnosis of sepsis.

Objective: 1) To find out the incidence of positive blood culture in suspected cases of septicaemia in children (0-12 years) with antibiotic sensitivity. 2) To study the significance of CRP, and Absolute Neutrophil Count in diagnosis of paediatric bacteraemia/septicaemia and correlation with blood culture results.

Methods: The study was carried out in MGM Medical college and Hospital, Kamothe and MGM hospital, Kalamboli, Navi Mumbai in the period of February 2021 - January 2022. 110 blood samples received in microbiology lab were processed for blood culture and antibiotic sensitivity. CRP test is done by slide agglutination method and Total leucocyte count was done in haematological blood cell counter. Inclusion criteria: Children below 12 years of age and with clinical features suggestive of Bacteraemia/Septicaemia.

Result: Out of 110 samples, 52 (47.27%) samples showed growth and 58 (52.73%) did not show any growth. Among 52 samples showing growth, 46 (79.31%) were the known bacterial pathogens and 6 (10.34%) were skin contaminants (3 CoNS, 3 Candida species). Among the 110 samples 51.82% were negative and 48.18% were positive for CRP. Among the 46 positive blood cultures, the ANC Range value was normal in 30 (65.21%), high in 10 (21.73%) and low in 06 (13.06%) cases, mean ANC value was normal in 15 (32.60%), high in 26 (56.5%) and low in 05 (1.08%) of the samples, and mean neutrophil percentage was normal in 18 (39.13%), high in 25 (54.34%) and low in 03 (6.5%) samples.

Conclusion: Out of 110 blood culture samples studied, 52 (47.27%) samples showing bacterial growth 48.18% were CRP positive and 51.82% were CRP negative. In 7 samples, CRP was positive but blood culture was negative. This could be because of prior antibiotic treatment which has inhibited the bacterial growth in the blood cultures. The positive predictive value (PPV) of ANC range, ANC mean and mean neutrophil percentage was 21.8%, 56.5% and 54.3% respectively. The reliable hematological parameters for septicaemia are Mean of Absolute Neutrophil Count and Mean of Neutrophil percentage. Range of Absolute Neutrophil Count in very wide and was normal in majority cases. Hence it is not reliable criteria.

Keywords: Septicaemia; Bacteriamia; C Reactive Protein; Absolute Neutrophil Count; Antibiotic Sensitivity

Introduction

Septicaemia is a common cause of morbidity and mortality in neonates and children. Neonates are particularly vulnerable to infections because of their weak immune barrier. Several risk factors have been identified both in the neonates and the children who make them susceptible to infections [1]. Bacteraemia is the presence of viable bacteria in the circulating blood. Septicaemia is the septic disease caused by the multiplication of microorganisms in the circulating blood [2]. The detection of microorganisms in a patient’s blood has a great diagnostic and prognostic significance. The positive blood culture report which is a gold standard for the diagnosis of neonatal sepsis, requires 48-72 hours of time [3]. In addition to the blood culture, various laboratory tests have been evaluated for the diagnosis of systemic infection in neonates. Complete blood count (CBC) with the various neutrophil parameters and C-reactive protein (CRP) are the most frequently used tests [4]. The determination of the bacterial profile and their antibiotic sensitivity pattern will guide in the infection control and rational use of antibiotic in the locality.

Materials and Methods

The study was carried out in MGM Medical college and Hospital, Kamothe and MGM hospital, Kalamboli, Navi Mumbai in the period of February 2021 – January 2022.

110 blood samples received in microbiology lab were processed for blood culture and antibiotic sensitivity. For CRP, serum sample was taken and EDTA sample was taken for Total Leukocyte and Differential Leukocyte Count (Absolute Neutrophil Count and percentage of Neutrophil.).

The blood culture bottle was sub cultured on Blood agar and MacConkey agar after 24 hrs, 3 days and 7 days. The blood culture bottle was incubated for 7 days before being reported as negative. The CRP test was done by slide agglutination method.

Total leucocyte count was done in haematological blood cell counter (SYSMEX KX21). Differential Leucocyte Count was done by examining the peripheral blood smear.

ANC was calculated by following formula: - TLC x % of neutrophil count/100

Result

Out of 110 samples, 52 (47.27%) samples showed growth and 58 (52.73%) did not show any growth. Among 52 samples showing growth, 46 (79.31%) were the known bacterial pathogens and 6 (10.34%) were skin contaminants (3 CoNS, 3 Candida species). The highest rate of infection was seen in the age group of 6-8 yrs (80%) followed by 2-4 yrs (66.6%). Male children show little more preponderance of infection than females i.e. 1.1:1. (Figure 1).

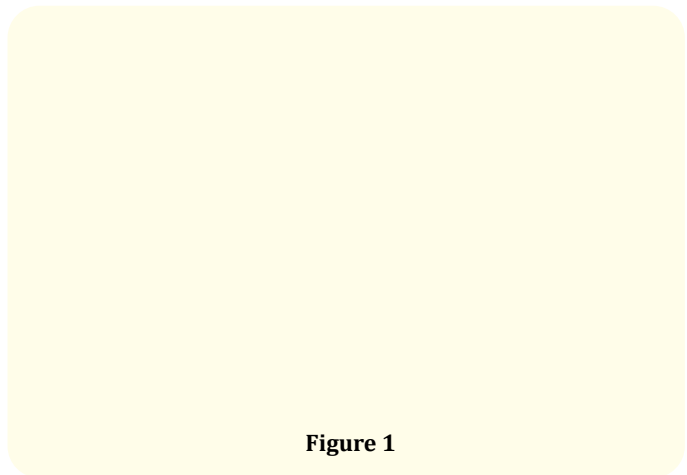


Figure 1

Among the 46 positive blood cultures, the ANC Range value was normal in 30 (65.21%), high in 10 (21.73%) and low in 06 (13.06%) cases, the mean ANC value was normal in 15 (32.60%), high in 26 (56.5%) and low in 05 (1.08%) of the samples and the mean neutrophil percentage was normal in 18 (39.13%), high in 25 (54.34%) and low in 03 (6.5%) samples. the highest PPV value with ANC Mean (56.52%) followed by mean neutrophil percentage (54.34%). The lowest PPV value was seen in ANC based on range (21.73%) (Table 1).

Number of samples	Absolute Neutrophil count %		
	Normal	High	Low
46	30 (65.21%)	10 (21.73%)	6 (13.06%)

Table 1

Among the 110 samples 51.82% were negative and 48.18% were positive. In 7 samples, CRP was positive but blood culture was negative. Among the 53 CRP Positive samples, the maximum samples (37.73%) showed positive CRP in 1:2 dilutions, followed by 1:4 (33.96%) and 1:8 (28.30%).

Out of 46 samples with known pathogens, 36.95% were gram positive isolates and 63.04% were gram negative isolates. Among gram positive isolates, *Staphylococcus aureus* was the most common isolate (58.82%) and in gram negative isolates, *Acinetobacter* species was the most common (27.58%).

Figure 2

Levofloxacin (100%) was the most effective antibiotic against Gram Positive bacteria followed by Ciprofloxacin, and Linezolid (94.12%). Co-trimoxazole (52.94%) followed by Cefalexin, Roxithromycin and Lincomycin (58.82%) were the least effective antibiotics for Gram Positive bacteria. For *Staphylococcus* which was the highest isolates among the gram-positive organisms, the most effective antibiotics was Levofloxacin and Vancomycin (100%) followed by Linezolid and Ciprofloxacin (90%). For *Acinetobacter* species which was the highest isolates among the gram-negative organism, the most effective antibiotic was Ceftazidime, Lomefloxacin, Cefuroxime, Cefotaxime, Pefloxacin and Ofloxacin (87.5%) (Figure 3).

Figure 3

Discussion

For the effective management of septicaemia in children, study of bacteriological profile and their antibiotic sensitivity pattern plays a significant role. In this study blood culture positivity rate was 47.27%, similar result was found by Kumhar GD., *et al.* [5] and also by I Roy., *et al.* [6].

All the above study showed higher percentage growth of Gram Negative in comparison to Gram Positive Organisms. *Staphylococcus* was the most common among the Gram Positive and the Gram Negative growth showed little variations in the studies which is not significant.

In the study conducted by S. I. Nwadioha., *et al.* [7] bacterial isolates according to age groups; A (neonates), B (>28 days to <1 year) and C (1 year to <15 years) were 25.7%, 17.4% and 12.7% respectively. In the present study bacterial isolates according to age groups; A (neonates), B (>28 days to <1 year) and C (1 year to <15 years) were 41.86%, 37.93% and 44.74% respectively which shows variation with the study conducted by S.I. Nwadioha.

All the studies study showed the greater percentage of male population in comparison to female. This might be due to the presence of one X chromosome in males thus confers less immunological protection compared to female counterpart [12].

Blood culture is the 'gold standard' for diagnosis of septicemia; however, its accuracy has been questioned because of spurious positive results due to contamination and negative blood cultures in patients on antibiotics treatment. Thus, in addition to the blood culture, various laboratory tests have been evaluated in the diagnosis of systemic infection in neonates. Complete blood count (CBC) with the various neutrophil parameters and C-reactive protein (CRP) are the most frequently used.

Among 110 samples, 57 (51.82%) samples were CRP negative and 53 (48.18%) were CRP positive. Out of 53 CRP positive only 46 (86.8%) of them were blood culture positive and 7 were blood culture negative. 7 negative cases might be due to prior antibiotics treatment which could have inhibited the bacterial growth. In the study by Rekha Sriram [8], among the 115 samples, 102 (88.7%) were CRP positive and 13 (11.03%) were CRP negative. 58 of the 115 (50.43%) sample were Blood culture positive and 57 (49.56%)

were Blood culture negative. Of the 58 blood culture positive, 53 (91.4%) were CRP positive which shows similar result with the present study. 49 (86%) were CRP negative among the 57 negative blood culture samples.

The Positive Predictive Value (PPV) of ANC range, ANC mean and mean neutrophil percentage was 21.8%, 56.5% and 54.3% respectively. The above result showed that the highest PPV value was of ANC mean (56.5%) followed by mean neutrophil percentage (54.3%). The lowest PPV was seen with ANC range (21.8%). S. Khurshid Anwer, *et al.* [12] found the PPV of neutrophil count to be as 48.14% which was slightly low than the present study. The study concluded that none of the parameter when studied individually showed good correlation with the positive blood culture result. When the parameter were combined and studied the results were good for the early detection of septicemia. But the PPV found by P Kite, *et al.* [13] was 27% for neutrophil count and 81.2% for CRP.

In vitro sensitivity testing of this study showed that Levofloxacin (100%) was the most effective antibiotic against Gram Positive bacteria followed by Ciprofloxacin, and Linezolid (94.12%). Cotrimaxazole (52.94%) followed by Cefalexin, Roxithromycin and Lincomycin (58.82%) were the least effective antibiotics for Gram Positive bacteria. Kairavi. J. Desai, *et al.* [14] showed maximum sensitivity by Vancomycin (100%) for Gram positive organisms which was similar to the present study.

For Gram Negative Bacteria, highest percentage of sensitivity was seen with Ofloxacin (93.10%) followed by Pefloxacin (89.65%). Whereas Cefoperazone and Netillin (75.86%) was the less effective antibiotic for Gram Negative bacteria. Kairavi. J. Desai, *et al.* [14] showed maximum sensitivity by Cefoperazone/sulbactam (97%) and Piperacillin/tazobactam (98%) for Gram negative organisms.

For *Staphylococcus* which was the highest isolates among the gram positive organisms, the most effective antibiotics was Levofloxacin (100%) followed by Linezolid and Ciprofloxacin (90%). Kairavi. J. Desai, *et al.* [14] showed 100% sensitive to Vancomycin which was followed by Amikacin (84.77%), Cephalexin (64.7%) for the *Staphylococcus* isolates.

For *Acinetobacter* species which was the highest isolates among the gram negative organism, the most effective antibiotic was Ceftazidime, Lomefloxacin, Cefuroxime, Cefotaxime, Pefloxacin and

Ofloxacin (87.5%). Christo, *et al.* [16] from Manipal reported 6.5% of all cases of biologically proven sepsis as *Acinetobacter*. While Mishra, *et al.* [16] from Jamshedpur reported incidence of 11.1 per thousand live births and accounted of 31.5% of blood culture positive sepsis of *Acinetobacter*, which was slight similar to our study (27.59%).

Conclusions

From this study this has been conclude that blood culture still remains the gold standard method for the diagnosis for the identification of Bacteraemia and Septicemia. Others parameters individually do not have a significant diagnosis but when the findings of all were compared then it can give an idea of the infection. Male to female ratio was 1.1:1. Gram negative organisms are the majority to cause of infection. *Acinetobacter* species was the common Gram negative isolate whereas *Staphylococcus* was the common gram positive isolate.

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