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Research Article

# BIOCHEMICAL PROFILE, BACTERIAL PROFILE, AND ANTIBIOTIC SUSCEPTIBILITY PATTERN OF THE ISOLATES OF NEONATAL SEPTICEMIA IN TERTIARY CARE HOSPITAL, VISAKHAPATNAM

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**ABSTRACT**

**Objectives:** The objective of the study was to determine sensitivity, specificity, and predictive values of C-reactive protein (CRP), leukocyte count, platelet count, and blood culture as indicators of neonatal sepsis.

**Methods:** This prospective study was conducted in the Department of Paediatrics, GITAM Institute of Medical sciences and Research, Visakhapatnam during January 2019 to December 2019. The institutional ethics committee had approved the study. Eighty clinically suspected cases of neonatal sepsis constituted material of study. All neonates who were clinically suspected sepsis, categorized into 0–72 h (early onset) or late onset (>3 days) sepsis based on day of presentation. Detailed history and clinical findings were recorded in the pro forma and screened with CRP and various hematological tests with predetermined cutoff values and at the same time blood culture was sent. Concerning a clinical scenario CSF, urine analysis, chest X-ray, and infective focus swabs were all taken. The length of treatment and time spent in the hospital were recorded. The death rate was calculated, and numerous risk variables were evaluated.

**Results:** Intrapartum risk factors such as a prolonged rupture of membrane >24 h, a long labor, several filthy vaginal examinations (>3) before birth, and foul-smelling liquid were all linked to culture-proven newborn sepsis. Any of the two risk factors listed above was a good predictor of sepsis with a positive culture. Neonatal sepsis impacted a higher percentage of low birth weight and preterm babies. The sensitivity and negative predictive value of the I/T ratio and CRP were both high. The most prevalent isolates were *Klebsiella species*, followed by *Staphylococcus aureus* and *Escherichia coli*. While *S. aureus* was 80% sensitive to Cefotaxime and Amikacin, *Klebsiella species* and *E. coli* were only 20% sensitive. All were sensitive to Ofloxacin in range of 75-100%. Septicemia with multiorgan dysfunction was the most common mode of death with 100% risk of mortality.

**Conclusion:** Intraparum risk factors are significantly with culture proven sepsis. All sepsis screening parameters used were statistically significantly associated with culture proven sepsis. I/T ratio and CRP were more sensitivity and had high negative predictive value. CRP can be used as an early and predictable screening test for diagnosing neonatal sepsis.

**Keywords:** Septicemia, Culture, Leukocyte count, CRP, Mortality, Neonate.

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## INTRODUCTION

Neonatal sepsis is a bacteremia condition that is characterized by systemic infection signs and symptoms in the 1st month of life. Septicemia, meningitis, pneumonia, arthritis, osteomyelitis, and urinary tract infection of the baby are the most common direct causes of neonatal death [1]. Around 3.1 million babies die in the first 4 weeks of life worldwide, with preterm birth (28%), severe infection (26%), and birth asphyxia (23%) being the leading causes [2]. The incidence of neonatal sepsis was reported to be 29.9/1000 live births, according to data from the National Neonatal Perinatal Database 2002–03, which was collected from 18 institutions across India. Early-onset sepsis (EOS) accounted for 67% of all sepsis cases. Neonatal septicemia has always been a difficulty because of its high frequency and poor prognosis, despite excellent treatment with current antibiotics. It is challenging to determine the best diagnosis and treatment options. The signs and symptoms are varied, and there is a significant mortality rate, so it is critical to determine whether the newborn has sepsis and begin treatment as soon as possible. It is not possible to confirm the diagnosis quickly with a definite culture. Only 3 to 5 per thousand neonates hospitalized to the neonatal intensive care unit had septicemia confirmed by culture [3,4]. Although blood culture is still the gold standard, due to the advent and spread of antibiotic resistance, which has been established as a global problem, its non-availability in most secondary and tertiary neonatal care settings results in high costs and contamination risks [5]. Sepsis screen tests including WBC indices and C-reactive protein (CRP) are simple, inexpensive, quick, and easily accessible measures with reasonable diagnostic accuracy, particularly when performed together. In critical septicemic newborns, early and rational antibiotic therapy might be initiated on this basis [6-8]. As a result, the goal of this study is to find out how sensitive, specific, and predictive CRP, leukocyte count, platelet count, and blood culture are as indicators of newborn sepsis.

## MATERIALS AND METHODS

### Source of data

This prospective study was conducted in the Department of Paediatrics, GITAM Institute of Medical sciences and Research, Visakhapatnam during January 2019 to December 2019. The blood sample was collected from 80 clinically suspected cases of neonatal sepsis constituted material of study. Detailed history and clinical findings were recorded in the pro forma.

### Inclusion criteria

Neonates presenting with following:

- Perinatal risk factors
- Low birth weight prematurity
- Birth asphyxia home delivery

- PROM more than 24 h
- Maternal fever

**Clinical risk factors include**

Poor nutrition, tiredness, and decreased activity, Sclerema, fever, jaundice, apnea, tachypnea, abdominal distension, vomiting, diarrhea, mottling of the skin, and tendencies to bleed Seizures were included in the study.

**Exclusion criteria**

Neonates who received antibiotics before admission. Neonates with major congenital malformations were excluded from the study.

**Methods**

The institutional ethics committee had approved the study. Based on the day of presentation, all neonates were classified as having 0–72 h (early onset) or late onset (>3 days) sepsis. The pro forma had a detailed history as well as clinical results. Perinatal risk variables were identified in EOS patients, and each baby was assigned a score based on the septic score in Table 1.

All neonates with clinical symptoms or a septic score of more than 4 were examined using CRP and several hematological parameters with predetermined cutoff values, and a blood culture was sent at the same time. CSF, urine tests, and infective focus swabs were all obtained in relation to the clinical scenario. The following are the cutoff values for positive quick screening tests in this study: Total leukocyte count (Leukopenia): 5,000 cells/cu.mm; absolute neutrophil count (Neutropenia): 1750 cells/cu.mm; band cell count to total neutrophil count ratio (I/T): > 0.2; and platelet count (thrombocytopenia): 1.5 lakhs/cu.mm. If CRP was positive, empirical antibiotic therapy was started in the NICU according to antibiotic guidelines while waiting for culture results. In all neonates, the length of treatment and hospital stay was recorded. The newborns who were discharged were monitored in the NICU-OPD.

**Sample collection**

A 5 cm radius around the venipuncture site was sterilized with 70% alcohol, rubbed firmly, and allowed to dry. Following that, Povidone-iodine was applied in concentric circles over the location and let to dry for at least 1 min. A sterile syringe was used to draw about 3–4 ml of blood, of which 1 ml was inoculated aseptically into a culture bottle, 1 ml was allowed to clot in a sterile bottle to collect serum for estimation of CRP, and the remaining 2 ml was collected in a sterile bottle containing the anticoagulant EDTA for estimation of the total WBC count, absolute neutrophil count, absolute neutrophil count, band cell count, and I/T ratio.

**Blood culture**

A dilution of 1 in 10 was achieved by drawing 1 ml of blood aseptically and inoculating it into a blood culture vial containing 10 ml of brain heart infusion broth. The broth for the brain heart infusion was made and distributed in McCartney bottles that had been autoclaved. The blood culture bottles were inoculated and then incubated for 7 days at 37°C under aerobic conditions. After 24 h of incubation, the first subculture was performed, followed by the 2nd on the 3rd days, and the last on the 7th day. Chocolate agar, 5% sheep blood agar, and MacConkey agar plates were used for subcultures. The inoculation plates were incubated aerobically for 24 h at 37°C in the incubator, and the plates were monitored for growth. According to Mackie and McCartney, colony features, Grams staining, and routine biochemical tests were used to identify the growth. At the end of 7 days, cultures that did not produce any growth after three subcultures were classified as negative.

**Table 1: Perinatal infection risk score**

| S. No. | Perinatal risk factor | Risk score |
|---|---|---|
| 1. | Foul smelling liquor | 2 |
| 2. | Unclean vaginal examination done before delivery | 2 |
| 3. | Duration of labor exceeding 24 h | 2 |
| 4. | Birth asphyxia (Apgar<6 at 1 min) | 2 |
| 5. | Birth weight 2.5 kg or less and/or gestation age<37 weeks. | 3 |
| 6. | Duration of rupture of membrane before delivery>24 h | 1 |
| 7. | Maternal pyrexia | 1 |
| | Total score | 13 |

Action based on score: Score 0–3; observe clinically score>4/=: Investigate

**Antibiotic susceptibility testing**

All isolates were tested for antibiotic susceptibility using commercially available disks on Miller Hinton agar using the Kirby–Bauer disk diffusion technique, as per CLSI standards. The following antibiotics Amikacin, Gentamycin, Penicillin, Erythromycin, Amoxyclav, Ciprofloxacin, Cefotaxime Ofloxacin, Oxacillin, Cephalexine, Cefadroxil, Cefazoline, Methicillin, Vancomycin Ampicillin, Ceftazidime, Ceftriaxone, Cefuroxime, Ceftizoxime, and Carbencillin were tested for antibiotic susceptibility.

**CRP assay**

This test is performed using a diagnostic kit for *in vitro* detection of CRP in human serum utilizing Span Diagnostics Ltd. quick slide latex agglutination qualitative approach. The antigen in the kit has a sensitivity of 6 ug/ml for visible agglutination. As a result, a CRP value of >6 ug/ml was considered a positive test in our study.

**Other hematological tests**

The total leukocyte count, differential count, absolute neutrophil count, band cell count, I/T ratio, and platelet count were calculated as per standard hematological method.

**Statistical analysis**

Data were analyzed statistically using Statastica 24.0 version. Tables and charts show the findings for each parameter in numbers and percentages. The Chi-square test of significance was used to compare proportions. Sensitivity, Specificity, Positive predictive accuracy, and negative predictive accuracy were estimated using the number of true positives, false positives, true negatives, and false negatives values. "$p<0.05$" was considered as suggesting statistical significance in the aforementioned test.

**RESULTS**

Out of 80 cases studied, 41 cases yielded a positive blood culture giving a success rate of 55.55% (Table 2). Higher proportion of late onset sepsis (LOS) (66.66%) was culture positive compared to EOS (44.66%). Out of 80 cases studied, 54 (67.5%) were males and 26 (32.5%) were females. Males were more affected compared to females with 1.6:1. This is not significant with respect to culture positivity. Out of 80 suspected sepsis, 46 cases (57.5%) were preterm. Among 41 culture positive, 27 (65.8%) were preterm. About 68% of early onset and 62% of late onset culture proven sepsis babies were preterm (Table 3). Out of 80 cases of sepsis, 58 (72.5%) cases were below 2.5 kg; 17.5 % of them were very low birth weight (1-1.5kg). Among 41 culture positive, 31 (75%) were below 2.5 kg and it was significant. 19 of 25 (76%), of the early onset culture proven sepsis had their birth weight below 2.5 kg. among LOS 76% of them were below 2.5 kg (Table 3). Out of 80 cases, 46 were inborn babies. Inborn admissions with culture proven sepsis were more in early onset 18 (72%) and LOS 10 (62%) group. Out born admissions with culture proven sepsis were more in early onset 7(28%) and LOS 6(37.5%) group. 32 of 41 (78%) of culture positive case were delivered spontaneously without assistance. Other

**Table 2: Distribution of culture positivity in sepsis**

| Culture | EOS (%) | LOS (%) | Total (%) |
|---|---|---|---|
| Culture Positive | 25 (44.6%) | 16 (66.66%) | 41 (51.25%) |
| Culture Negative | 31 (55.35%) | 8 (33.33%) | 39 (48.75%) |
| Total | 56 | 24 | 80 |

EOS: Early onset sepsis, LOS: Late onset sepsis

9 (22%) were assisted delivery. 17 of 80 (22%) of total septicemic newborns were born of assisted delivery. Out of 56 early onset septic babies, higher proportion of babies had preterm and birth asphyxia as risk factor, both in culture proven and culture negative cases. Hence, no significance was found between two groups. Higher proportion of culture proven sepsis had intrapartum risk factor such as duration of labor >24 h, unclean vaginal examination, and foul smelling liquor and they were significantly associated with culture proven sepsis (Table 4). PROM >24 h and maternal fever had no significant association. Higher proportion of babies with culture proven sepsis had more than two factors (Table 5). Higher proportions of septic babies had vague symptoms such as variation in established feeding pattern with failure to suck and lethargy (Table 6). I/T ratio and CRP were positive in higher proportion of culture positive cases. Neutropenia, leukopenia, and thrombocytopenia are positive in higher proportion in culture proven cases compared culture negative cases. All screening parameters are significant with respect to culture proven sepsis (Table 7). I/T ratio and CRP have good sensitivity and negative predictive value. Neutropenia and leukopenia have highest specificity and positive predictive value. If two or more of the above tests are positive, sensitivity, and negative predictive value of the screening tool increased above 90% (Table 8). Septicemia was the commonest mode of clinical presentation, constituting about 48.75% of cases, followed by pneumonia and then meningitis. Among EOS, septicemia (60.3%), followed by pneumonia were the commonest presentation. Among LOS pneumonia (37.5%), followed by meningitis (25%) and infective diarrhea were the commonest mode of presentation (Table 9). Out of 41 culture positive cases, 14 (34.14%) were gram positive isolates and 27 (65.85%) were gram negative isolates. Klebsiella (46.3%), followed by *Staphylococcus aureus* (29.2%) were the most common isolates (Table 10). Methicillin sensitive *S. aureus* was the major Gram-positive isolate showing 100% susceptibility to ofloxacin, methicillin, and vancomycin, while 75–80% were susceptible to amikacin, cefatoxime, and cefazoline. MRSA was 100% susceptible to vancomycin, fallowed ofloxacin. All coagulase negative Staphylococci were susceptible to ofloxacin and vancomycin, while 50% of them were susceptible to Amikacin, Amoxyclav, Cefataxime, Cefazoline, and Methicillin (Table 11). The major Gram-negative isolates were *Klebsiella pneumoniae* 19 (46.3%), of these nearly 75% were sensitive to Ofloxacin and Ceftizoxime. About 75% of *Escherichia coli* isolates were sensitive to Ofloxacin. All *Pseudomonas aeruginosa* isolates were sensitive to Ofloxacin, Ceftizoxime and Carbencillin, while 50% of them were sensitive to Amikacin, Gentamycin, Cefotaxime, Ceftriaxone, and Ceftizoxime. Entrobacter species was sensitive to only Ofloxacin. *Proteus vulgaris* was resistant to all the antibiotics, while *Citrobacter freundii* were susceptible to most of antibiotics. Among 80 cases, 27 were died of sepsis, mortality rate being 33.75%. About 43.9% of culture positive and 23% of the culture negative cases died of sepsis which was statistically significant (p=0.005). Case fatality rate of 12 (48%) among EOS and 6 (37.5%) among LOS.

**Table 3: Distribution of cases according to the birth weight and gestational age**

| | Culture positive | | Culture negative | | Total |
|---|---|---|---|---|---|
| | EOS | LOS | EOS | LOS | |
| Birth weight | | | | | |
| NBW (>2.5) | 6 (24%) | 4 (25%) | 11 | 1 | 22 (27.5%) |
| LBW (1.5–2.5) | 16 (64%) | 8 (50%) | 17 | 3 | 44 (55%) |
| VLBW (1–1.5) | 3 (12%) | 4 (25%) | 3 | 4 | 14 (17.5%) |
| p=0.002 (Significant) | | | | | |
| Gestational age | | | | | |
| Preterm | 17 (68%) | 10 (62.5%) | 14 | 5 | 46 (57.5%) |
| Term | 8 (32%) | 6 (37.5%) | 17 | 3 | 34 (42.5%) |
| Total | 25 | 16 | 31 | 8 | 80 |

p=0.062 (Insignificant). NBW: Normal birth weight, LBW: Low birth weight, VLBW: Very low birth weight, EOS: Early onset sepsis, LOS: Late onset sepsis

## DISCUSSION

The goal of this study was to learn about the different etiological agents that cause neonatal septicemia and their antibiotic susceptibility patterns, as well as to correlate the efficacy of the sepsis score and sepsis screen markers like CRP with blood culture results. In the current investigation, the most culture positive cases were identified in neonates <3-days-old (early onset septicemia) compared to neonates older than 3 clays (late onset septicemia). Varsha *et al*. [8] and the National Neonatal and Perinatal Database both showed a higher proportion of early onset septicemia patients. This could be due to ascending infection following rupture of membranes or during the passage of the baby through the infected birth canal or at the time of resuscitation in the labor room. It is possible that the increased proportion of EOS cases is attributable to neonates' undeveloped immune responses in the 1st week of life, making them more susceptible to infections during this time [9]. In this study, the proportion of septicemia cases with a positive culture was greater among premature infants. Our findings were equivalent to those of Khatua *et al*. [10] and Joshi *et al*. [11]. Other studies have found that term neonates have a higher proportion of instances than preterm neonates, which is likely due to variations in demographic features and the presence of predisposing variables (preterm incidence) among them. Due to a lack of intrinsic defensive mechanisms, including humeral and cellular defense mechanisms, preterm infants are more susceptible to infections. The incidence of septicemia is inversely related to the gestational age of the newborns, according to Stoll *et al*. [9]. The current study clearly reveals that developing definitive septicemia is more common in instances with dirty PV before delivery,

**Table 4 : Antibiotic susceptibility pattern of Gram-negative bacterial isolates**

| Antibiotics | *Klebsiella* | *E. coli* | *Pseudomonas* | *Enterobacter* | *Proteus* | *Citrobacter* |
|---|---|---|---|---|---|---|
| Total | 19 | 4 | 1 | 1 | 1 | 1 |
| Ampicillin | 1 (5.2%) | 0 | 0 | 0 | 0 | 0 |
| Amikacin | 4 (21%) | 1 (25%) | 1 (50%) | 0 | 0 | 1 (100%) |
| Gentamycin | 2 (10.4%) | 0 | 1 (50%) | 0 | 0 | 1 (100%) |
| Ofloxacin | 15 (78.9%) | 3 (75%) | 2 (100%) | 1 (100%) | 0 | 1 (100%) |
| Cefotaxime | 4 (21%) | 1 (25%) | 1 (50%) | 0 | 0 | 0 |
| CTR | 4 (21%) | 2 (50%) | 1 (50%) | 0 | 0 | 0 |
| CAZ | 5 (26.3%) | 2 (50%) | 2 (100%) | 0 | 0 | 1 (100%) |
| CZX | 15 (78.9%) | 2 (50%) | 1 (50%) | 0 | 0 | 1 (100%) |
| CB | 1 (5.2%) | 0 | 2 (100%) | 0 | 0 | 1 (100%) |

extended rupture of membranes during 24 h, and prolonged labor for >24 h. This research is comparable to those of Yancey *et al*. [12] and St. Geme *et al*. [13]. The current study also revealed that virtually an equal number of cases had birth weights of less than 2.5 kg and gestational ages of <37 weeks as risk factors for septicemia. This is comparable with study conducted by Dawodu *et al*. [14], Tallur *et al*. [15], and Roy *et al*. [16]. In this investigation, compared to other studies, an Apgar score of 6 or above, indicating birth hypoxia, was a major risk factor for sepsis. These variations probably reflect differences in the rates of occurrence of the predisposing risk factors in the various studies. In the current investigation, clinical chorioamnionitis was diagnosed by the presence of foul-smelling fluid and maternal fever in 31.3% of the culture-proven sepsis, which is equivalent to Yancey *et al*. [12] and Joseph *et al*. [13] studies. The disparities in the rates of incidence of perinatal risk factors are most likely due to differences in the rates of occurrence of predisposing risk factors among studies. The positivity rate in this study was 51.25%, with 41 of the 80 cases analyzed being culture positive. The results of this investigation were equivalent to those of Tallur *et al*. [15] and Roy *et al*. [16], although Joshi *et al*. [11] and Sharma *et al*. [17] found very low culture positive. The time of

**Table 5: Distribution of perinatal risk factors among neonates with early onset sepsis**

| Risk factor | Culture positive | Culture negative | Total n=56 | p-value |
|---|---|---|---|---|
| | n=25 (%) | n=31 (%) | | |
| Birth wt<2.5 kg or GA<37 wks | 19 (76%) | 20 (64.5%) | 39 (69.6%) | 0.277 |
| Birth asphyxia (Apgar<6@ 1 min) | 18 (72%) | 19 (61.2%) | 37 (66%) | 0.3125 |
| PROM>24 h | 16 (64%) | 11 (35.4%) | 27 (48.2%) | <0.005* |
| Duration of labor>24 h | 16 (64%) | 11 (35.4%) | 27 (48.2%) | <0.005* |
| Unclean vaginal examination | 23 (92%) | 21 (67.7%) | 44 (78.5%) | <0.005* |
| Foul smelling liquor | 10 (40%) | 7 (28%) | 17 (30%) | <0.005* |
| Maternal fever | 3 (12%) | 4 (12.9%) | 7 (12.5%) | 1.00 |
| More than 2 risk factors septic score>4 | 25 (100%) | 20 (64.5%) | 45 (80.3%) | <0.005* |

**Table 6: Distribution of clinical finding in neonatal sepsis**

| S. No. | Clinical presentation | Number of cases | Percentage |
|---|---|---|---|
| 1. | Refusal of feeds | 58 | 72.5 |
| 2. | Lethargy & weak reflexes | 65 | 81.5 |
| 3. | Hypothermia | 21 | 26.2 |
| 4. | Hyperthermia | 11 | 13.75 |
| 5. | Cyanosis | 18 | 22.5 |
| 6. | Dehydration | 5 | 6.25 |
| 7. | Tachypnea | 30 | 37.5 |
| 8. | Apnea | 13 | 16.25 |
| 9. | Chest retraction | 25 | 31.25 |
| 10. | Tachycardia | 39 | 48.75 |
| 11. | Shock (CRT>3 s) | 14 | 17.5 |
| 12. | Loose stools | 5 | 6.25 |
| 13. | Abdominal distension | 19 | 23.75 |
| 14. | Jaundice | 24 | 30 |
| 15. | Vomiting | 4 | 5 |
| 16. | High pitched cry | 9 | 11.25 |
| 17. | Convulsion | 13 | 16.25 |
| 18. | Bulging AF | 6 | 7.5 |
| 19. | Bleeding manifestation | 7 | 8.7 |
| 20. | Sclerema | 4 | 5 |

**Table 7: Correlation of sepsis screen parameters with the blood culture status**

| S. No. | Screening parameters | Culture positives (n=41) | Culture negative (n=39) | Total cases n=80 | p-value |
|---|---|---|---|---|---|
| 1. | CRP+ve | 32 (78%) | 23 | 55 (68.75%) | <0.005* |
| 2. | Leucopenia (<5000/cmm) | 12 (29.2%) | 2 | 14 (17.5%) | <0.005* |
| 3. | Neutropenia (<1750/cmm) | 7 (17%) | 1 | 8 (10%) | <0.005* |
| 4. | Thrombocytopenia (<1.5 lakh/cmm) | 11 (26.8%) | 3 | 14 (17.5%) | <0.005* |
| 5. | I/T ratio>0.2 | 33 (80.4%) | 22 | 55 (68.75%) | <0.005* |
| 6. | Two or more tests positive | 40 (97.5%) | 15 | 55 (68.75%) | <0.005* |

CRP: C-reactive protein

**Table 8: The sensitivity, specificity, positive predictive accuracy and negative predictive accuracy of sepsis screen parameters**

| S. No. | Screening parameters | Sensitivity (%) | Specificity (%) | PPV | NPV |
|---|---|---|---|---|---|
| 1. | CRP | 78% | 41% | 58.18% | 64% |
| 2. | Leucopenia (<5000/cmm) | 31.70% | 94.87% | 85.7% | 56% |
| 3. | Neutropenia (<1750/cmm) | 17% | 97.4% | 87.5% | 57.5% |
| 4. | Thrombocytopenia (<1.5 lakh/cmm) | 26.8% | 92.3% | 78.5% | 54.54% |
| 5. | I/T ratio>0.2 | 80.48% | 43.58% | 60% | 68% |
| 6. | Two or more tests positive | 97.5% | 61.5% | 72.5% | 96% |

PPV: Positive predictive value, NPV: Negative predictive value, CRP: C-reactive protein

**Table 9: Spectrum of clinical diagnosis among EOS and LOS**

| Clinical diagnosis | Culture positive | | Culture negative | | Total |
|---|---|---|---|---|---|
| | EOS n=25 | LOS n=16 | EOS n=31 | LOS n=8 | |
| Septicemia | 15 (60.3%) | 2 (12.5%) | 22 (70.9%) | 0 | 39 (48.75%) |
| Pneumonia | 9 (36%) | 6 (37.5%) | 7 (22.5%) | 3 (37.5%) | 25 (31.25%) |
| Meningitis | 1 (4%) | 2 (12.5%) | 1 (3.2%) | 2 (25%) | 6 (7.5%) |
| Infective diarrhea | 0 | 2 (12.5%) | 0 | 3 (37.5%) | 5 (6.25%) |
| Umbilical sepsis | 0 | 2 (12.5%) | 0 | 1 (12.5%) | 3 (3.75%) |
| NEC | 0 | 1 (6.25%) | 0 | 0 | 1 (1.25%) |
| Urinary tract infection | 1 (4%) | 0 | 1 (3.2%) | 0 | 2 (2.5%) |
| Septic arthritis | 0 | 1 (6.25%) | 0 | 0 | 1 (1.25%) |

EOS: Early onset sepsis, LOS: Late onset sepsis

**Table 10: Distribution of organisms with respect to EOS and LOS**

| Microorganisms | Culture Positive cases | | Total |
|---|---|---|---|
| | EOS n=25 | LOS n=16 | |
| Gram positive isolates | | | |
| *Staphylococcus aureus* | 8 (32%) | 6 (37.5%) | 14 (34.14%) |
| *MSSA* | 5 (20%) | 4 (25%) | 9 (21.9%) |
| *MRSA* | 2 (8%) | 1 (6.25%) | 3 (7.3%) |
| *Coagulase negative Staphylococci* | 1 (4%) | 1 (6.25%) | 2 (4.8%) |
| Gram negative isolates | 17 (68%) | 10 (62.5%) | 27 (65.85%) |
| *Klebsiella pneumoniae* | 11 (44%) | 8 (50%) | 19 (46.3%) |
| *Escherichia coli* | 2 (8%) | 2 (12.5%) | 4 (9.7%) |
| *Pseudomonas aeruginosa* | 1 (4%) | 0 | 1 (2.4%) |
| *Enterobacter cloacae* | 1 (4%) | 0 | 1 (2.4%) |
| *Proteus vulgaris* | 1 (4%) | 0 | 1 (2.4%) |
| *Klebsiella pneumoniae and Citrobacter freundii* | 1 (4%) | 0 | 1 (2.4%) |

EOS: Early onset sepsis, LOS: Late onset sepsis

**Table 11: Antibiotic susceptibility pattern of Gram Positive bacteria**

| Antibiotics | *Staphylococcus aureus* n=12 | | Coagulase Negative Staphylococci |
|---|---|---|---|
| | MSSA n=9 | MRSA n=3 | n=2 |
| Ampicillin | 1 (11.1%) | 0 | 0 |
| Penicillin | 1 (11.1%) | 0 | 0 |
| Amoxyclav | 6 (66.6%) | 1 (33.3%) | 1 (50%) |
| Oxacillin | 6 (66.6%) | 0 | 0 |
| Methicillin | 9 (100%) | 0 | 1 (50%) |
| Cefotaxime | 7 (77.7%) | 0 | 1 (50%) |
| Cefadroxil | 6 (66.6%) | 0 | 1 (50%) |
| Cefazoline | 7 (77.7%) | 0 | 1 (50%) |
| Amikacin | 7 (77.7%) | 2 (66.6%) | 1 (50%) |
| Gentamycin | 5 (55.5%) | 1 (33.3%) | 0 |
| Ciprofloxacin | 6 (66.6%) | 1 (33.3%) | 0 |
| Ofloxacin | 9 (100%) | 2 (66.6%) | 2 (100%) |
| Erythromycin | 2 (22.2%) | 1 (33.3%) | 0 |
| Vancomycin | 9 (100%) | 3 (100%) | 2 (100%) |

sampling, the amount of bacteremia in the baby, and the neonate's past antibiotic therapy all influence the culture positive. The current study found a significant case fatality rate among babies with refractory shock, DIC, respiratory failure, meningitis, and NEC, which was comparable to prior studies. This is likely due to the fact that a higher number of newborns were infected with highly pathogenic Gram-negative organisms, which were resistant to routinely used cephalosporins and aminoglycosides, as previously documented. Endotoxin-mediated multiple organ failure is most likely the cause of death. The death rate is also high because of high proportion of babies

are preterm and also low birth weight who lack inherent immunity to contain infection [18,19].

## CONCLUSION

Sepsis screening parameters based on CRP and hematological parameters are easily accessible, cost-effective, and quick screening procedures with strong sensitivity and negative predictive value, implying that the infection is improbable if either of the two screening tests is negative. Neutropenia and thrombocytopenia have a high specificity and are death predictors. CRP is a useful tool for both diagnosis and treatment. It has a high sensitivity and an excellent negative predictive value, allowing antibiotic treatment to begin in cases when there is no culture and no symptoms. This helps to shorten the time it takes to start antibiotic therapy.

## AUTHORS' CONTRIBUTION

The first and second authors KG and CS had performed the work, and wrote the first draft of the manuscript. The third author BS collected the literature and performed statistical analysis. The fourth and corresponding author corrected the final draft of the manuscript.

## CONFLICT OF INTEREST

The authors declared no conflict of interest.

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