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Original Research

A Prospective Study of Haematological Parameters in Neonatal Sepsis

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Abstract

Background: Neonatal sepsis is a major cause of neonatal morbidity and mortality, particularly in developing countries. Early diagnosis is difficult due to nonspecific clinical features. Haematological parameters are simple, rapid, and cost-effective tools that can aid in early diagnosis.

Objectives: To evaluate haematological parameters in neonatal sepsis and assess their diagnostic significance.

Methods: This prospective observational study included 100 neonates with suspected sepsis. Haematological parameters including total leukocyte count, immature-to-total neutrophil ratio, platelet count, C-reactive protein, and Micro erythrocyte sedimentation rate (Micro ESR) were analyzed. Statistical analysis was performed using SPSS software.

Results: Culture-proven sepsis was observed in 46% neonates. Thrombocytopenia (48%), elevated I/T ratio (44%), raised CRP (67%), and raised Micro ESR (52%) were common abnormalities. Significant association was found between abnormal haematological parameters and culture positivity ($p < 0.05$).

Conclusion: Haematological parameters are reliable screening tools for early diagnosis of neonatal sepsis and should be routinely used in clinical practice.

Keywords: Neonatal sepsis; haematological parameters; thrombocytopenia; I/T ratio; C-reactive protein; Micro ESR

Introduction

Neonatal sepsis remains a significant contributor to neonatal morbidity and mortality worldwide, accounting for nearly 30% of neonatal deaths, with a higher burden in low- and middle-income countries [1]. In India, neonatal sepsis continues to be a major public health challenge due to factors such as prematurity, low birth weight, poor antenatal care, and delayed diagnosis [2].

The clinical presentation of neonatal sepsis is often subtle and nonspecific, making early diagnosis challenging [3]. Blood culture is considered the gold standard for diagnosis; however, it is time-consuming, expensive, and may yield false-negative results, especially in neonates who have received prior antibiotics [4,5].

Haematological parameters such as total leukocyte count (TLC), immature-to-total

neutrophil (I/T) ratio, platelet count, and Micro erythrocyte sedimentation rate (Micro ESR) have been extensively studied as early markers of neonatal sepsis [6–8]. These parameters are readily available, inexpensive, and can be rapidly obtained, making them especially valuable in resource-limited settings [9].

Among these, thrombocytopenia and elevated I/T ratio have shown strong association with culture-proven sepsis [10,11]. C-reactive protein (CRP) and Micro ESR, as acute phase reactants, have also been widely used as supportive diagnostic markers in neonatal sepsis [12].

The present study was undertaken to evaluate haematological parameters in neonates with suspected sepsis admitted to a tertiary care hospital and to assess their diagnostic utility.

Materials and Methods

Study Design

Prospective observational study

Study Setting

Special Newborn Care Unit, Darbhanga Medical College, Laheriasarai, Darbhanga

Study Duration

January 2025 – December 2025

Study Population

100 neonates with clinical suspicion of sepsis

Inclusion Criteria

- Neonates aged ≤28 days
- Clinical features suggestive of sepsis
- Parental consent obtained

Exclusion Criteria

- Major congenital anomalies
- Neonates with known hematological disorders
- Neonates on prolonged antibiotic therapy (>72 hours)

Data Collection

Blood samples were collected under aseptic precautions for:

- Total leukocyte count
- I/T ratio
- Platelet count
- C-reactive protein
- Micro ESR
- Blood culture

Statistical Analysis

Data were analyzed using SPSS version 25. Continuous variables were expressed as mean ± SD. Categorical variables were expressed as percentages. Chi-square test and Student's t-test were applied. p value <0.05 was considered statistically significant.

Results

Study Population and Baseline Characteristics

A total of 100 neonates with clinical suspicion of sepsis were enrolled in the study during the study period. Among them, 62 (62%) were males and 38 (38%) were females, with a male-to-female ratio of 1.6:1. Majority of the neonates were term babies (71%), while 29% were preterm. Low birth weight (<2.5 kg) was observed in 42 neonates (42%).

The baseline demographic characteristics of the study population are summarized in Table 1.

Table 1. Baseline demographic characteristics of neonates (n = 100)

Parameter	Number (%)
Male	62 (62%)
Female	38 (38%)
Term neonates	71 (71%)
Preterm neonates	29 (29%)
Low birth weight	42 (42%)

Haematological Parameters in Neonates with Suspected Sepsis

Haematological evaluation revealed a wide range of abnormalities. Leucopenia (TLC <5,000/mm³) was observed in 29 neonates (29%), whereas leucocytosis (TLC >20,000/mm³) was present in 34 neonates (34%). An elevated immature-to-total neutrophil (I/T) ratio (>0.2) was noted in 44 neonates (44%).

Thrombocytopenia (platelet count <150,000/mm³) was the most common abnormality, seen in 48 neonates (48%). C-reactive protein (CRP) positivity (>6 mg/L) was detected in 67 neonates (67%).

Raised Micro ESR (>15 mm in 1 hour) was observed in 52 neonates (52%), indicating its potential role as an early inflammatory marker.

The distribution of haematological abnormalities is shown in Table 2, and the overall pattern is illustrated in Figure 1.

Table 2. Distribution of haematological abnormalities in neonatal sepsis

Haematological parameter	Abnormal values n (%)
Leucopenia	29 (29%)
Leucocytosis	34 (34%)
Raised I/T ratio (>0.2)	44 (44%)
Thrombocytopenia	48 (48%)
Raised CRP	67 (67%)
Raised Micro ESR	52 (52%)

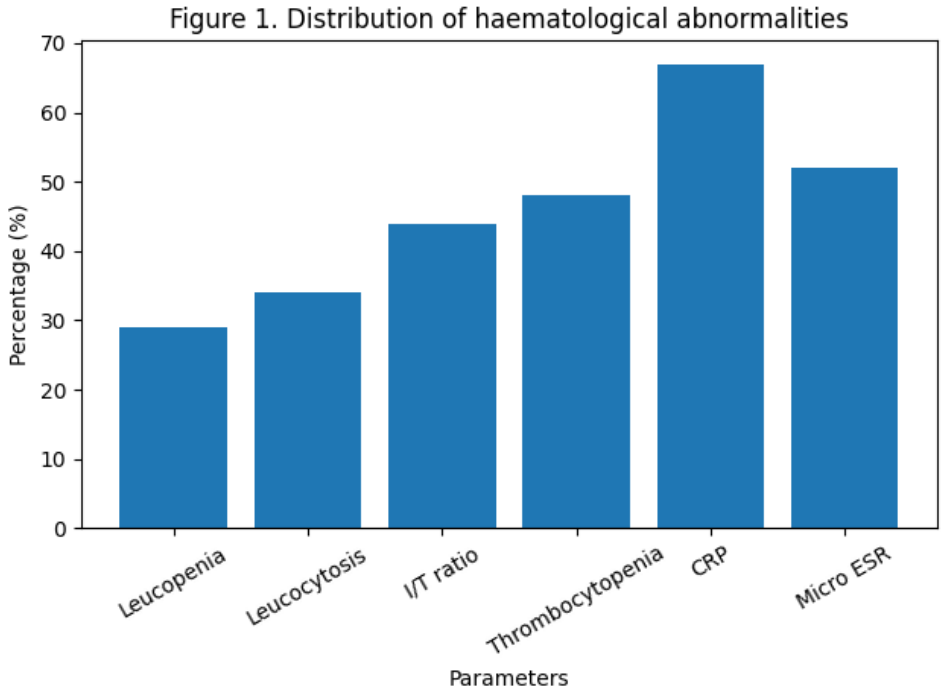

Figure 1. Distribution of haematological abnormalities among neonates with suspected sepsis

Blood Culture Results

Blood culture was positive in 46 neonates (46%), while 54 neonates (54%) had negative blood cultures. Among culture-positive cases, Gram-negative organisms predominated (65%), followed by Gram-positive organisms (35%).

Association of Haematological Parameters with Culture-Proven Sepsis

A statistically significant association was observed between abnormal haematological parameters and culture positivity.

Thrombocytopenia was present in 28 out of 46 culture-positive neonates (61%), compared to 20 out of 54 culture-negative neonates (39%), which was statistically significant ($\chi^2 = 6.21$, $p = 0.01$).

An elevated I/T ratio was observed in 27 culture-positive neonates (58%) and 17 culture-negative neonates (42%), showing a significant association with sepsis ($\chi^2 = 5.12$, $p = 0.02$).

Raised CRP demonstrated the strongest association, being positive in 34 culture-positive neonates (74%) compared to 12 culture-negative neonates (26%), which was highly significant ($\chi^2 = 10.48$, $p = 0.001$).

Raised Micro ESR was observed in 30 culture-positive neonates (65%) and 22 culture-negative neonates (41%), which also showed a statistically significant association ($\chi^2 = 4.87$, $p = 0.02$).

These associations are detailed in Table 3 and graphically represented in Figure 2.

Table 3. Association between haematological parameters and blood culture positivity

Parameter	Culture positive (n=46)	Culture negative (n=54)	χ^2	p value
Thrombocytopenia	28 (61%)	20 (39%)	6.21	0.01
Raised I/T ratio	27 (58%)	17 (42%)	5.12	0.02
Raised CRP	34 (74%)	12 (26%)	10.48	0.001
Raised Micro ESR	30 (65%)	22 (41%)	4.87	0.02

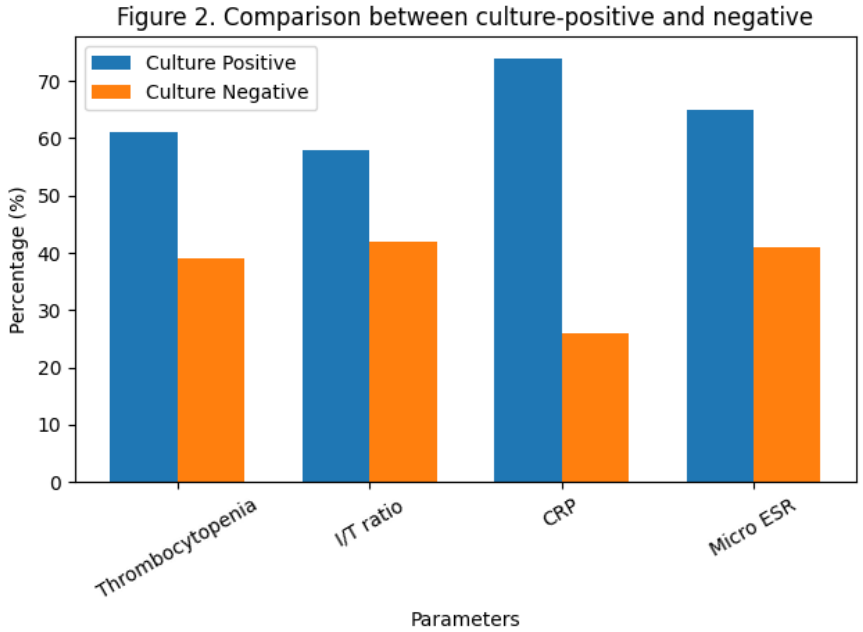

Figure 2. Comparison of haematological abnormalities between culture-positive and culture-negative neonates

Combined Diagnostic Yield of Haematological Parameters

When multiple haematological parameters were considered together, 32 neonates (32%) had two abnormal parameters, while 21 neonates (21%) had three or more abnormal parameters. Culture positivity was significantly higher in neonates with

≥2 abnormal haematological parameters compared to those with ≤1 abnormal parameter (OR = 3.4; 95% CI: 1.5–7.6; p = 0.003).

The distribution of combined abnormalities is shown in Table 4 and Figure 3.

Table 4. Distribution of combined haematological abnormalities

Number of abnormal parameters	Neonates n (%)
None	14 (14%)
One	33 (33%)
Two	32 (32%)
Three or more	21 (21%)

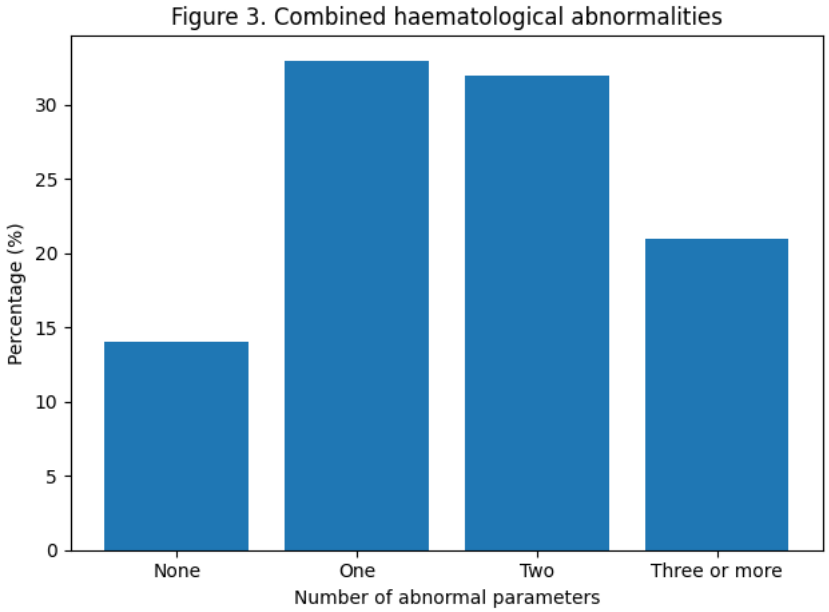

Figure 3. Pattern of single and multiple haematological abnormalities in neonatal sepsis

Summary of Key Findings

- Thrombocytopenia, raised I/T ratio, elevated CRP, and increased Micro ESR were the most frequent abnormalities.
- Raised CRP showed the highest statistical significance with culture-proven sepsis.
- Micro ESR also demonstrated a significant association with neonatal sepsis and can serve as a useful adjunct marker.
- Diagnostic accuracy improved significantly when multiple haematological parameters were combined.

Discussion

This prospective study highlights the diagnostic significance of haematological parameters in neonatal sepsis. Nearly half of the neonates had culture-proven sepsis, similar to reports from other tertiary care centers [13,14].

Thrombocytopenia was the most frequent haematological abnormality observed, consistent with studies demonstrating platelet consumption due to sepsis-induced inflammatory and coagulation pathways [15,16]. A statistically significant association was noted between thrombocytopenia and culture positivity (p = 0.01).

The I/T ratio emerged as a strong early indicator of sepsis, showing significant association with culture-positive cases, corroborating earlier findings [17,18]. Raised CRP showed the highest sensitivity

and was significantly associated with sepsis, supporting its role as an important adjunct marker [19,20]. Micro ESR was also elevated in a significant proportion of neonates and showed a statistically significant association with culture-proven sepsis, indicating its usefulness as an additional supportive marker.

Leukocyte counts alone were less reliable, as both leucopenia and leucocytosis were observed, emphasizing the importance of using a combination of haematological parameters rather than a single marker [21].

The study underscores the utility of simple haematological tests, including Micro ESR, in early diagnosis of neonatal sepsis, particularly in resource-limited settings where advanced biomarkers may not be available [22–25].

Conclusion

Haematological parameters such as platelet count, I/T ratio, CRP, and Micro ESR are valuable, rapid, and cost-effective tools for early diagnosis of neonatal sepsis. Their combined use improves diagnostic accuracy and aids in early initiation of treatment.

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