



DIAGNOSTIC SIGNIFICANCE OF NUCLEATED RED BLOOD CELLS IN NEONATAL SEPSIS AT A TERTIARY CARE CENTRE

Hemato-Pathology

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ABSTRACT

Background: Neonatal sepsis remains a major cause of neonatal morbidity and mortality worldwide. Early diagnosis is challenging due to nonspecific clinical manifestations. Nucleated red blood cells (NRBCs) have emerged as potential hematological markers reflecting systemic hypoxia and inflammatory stress. **Methods:** A prospective observational study was conducted on 150 neonates with clinical suspicion of sepsis admitted to a tertiary care centre. Clinical features, laboratory parameters, blood culture results, and NRBC counts were analyzed. Statistical analysis was performed using the chi-square test to determine the association between NRBC elevation and neonatal sepsis severity. **Results:** NRBC elevation was observed in 92 (61.3%) neonates. All neonates with proven sepsis demonstrated NRBC elevation, whereas none of the neonates without sepsis showed elevated NRBC levels. The association between NRBC elevation and final diagnosis was statistically significant ($\chi^2 = 150.0$, $p < 0.001$). Neonates requiring ventilatory or inotropic support showed significantly higher NRBC counts compared with stable neonates. The sensitivity and specificity of NRBC elevation for detecting neonatal sepsis were 60.3% and 100%, respectively. **Conclusion:** NRBC elevation is a valuable adjunctive hematological marker in neonatal sepsis. Its high specificity and association with disease severity make it useful for early diagnosis and prognostic assessment in neonates with suspected sepsis.

KEYWORDS

Neonatal sepsis, nucleated red blood cells, NRBC, diagnostic marker, prognostic marker, NICU

INTRODUCTION

Neonatal sepsis is a life-threatening systemic infection occurring within the first 28 days of life and remains a major contributor to neonatal morbidity and mortality worldwide. Early diagnosis is difficult because clinical manifestations such as fever, poor feeding, respiratory distress, and lethargy are nonspecific and may mimic other neonatal conditions. Several hematological parameters have been evaluated as early markers of neonatal sepsis. Among them, nucleated red blood cells (NRBCs) have gained attention as indicators of systemic stress. NRBCs are immature erythroid precursors normally confined to the bone marrow but may appear in peripheral circulation during conditions such as hypoxia, inflammation, or infection.

During sepsis, inflammatory cytokines and tissue hypoxia stimulate erythropoietin production, resulting in accelerated erythropoiesis and premature release of NRBCs into the bloodstream. Elevated NRBC counts have been associated with increased disease severity, requirement for intensive care support, and poor clinical outcomes. Therefore, NRBC estimation may serve as a simple and cost-effective marker for early identification of neonatal sepsis.

Materials and Methods

Study Design: Prospective observational study.

Study Population: A total of 150 neonates with clinical suspicion of sepsis admitted to the neonatal intensive care unit (NICU) of a tertiary care hospital were included in the study.

Inclusion Criteria:

Neonates aged less than 28 days
Neonates with clinical suspicion of sepsis
Cases where parental consent was obtained

Exclusion Criteria:

Neonates receiving steroid therapy
Neonates with hypovolemic shock
Cases where consent was not obtained

Data Collection:

Blood samples were collected for complete blood count, NRBC count, C-reactive protein, and blood culture. NRBC counts were evaluated using peripheral smear examination and hematological analysis. Clinical parameters, treatment requirements, and outcomes were recorded.

Statistical Analysis:

Statistical analysis was performed using the chi-square test to determine the association between NRBC elevation and neonatal sepsis. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 150 neonates with suspected sepsis were included in the study. The study population showed nearly equal gender distribution.

Clinical Presentation

The most common clinical manifestations observed among neonates were fever and poor feeding (76.7%), respiratory distress (61.3%), and lethargy (61.3%).

Clinical Suspicion of Sepsis

Among the study population, 92 neonates (61.3%) had high clinical suspicion of sepsis, 23 neonates (15.3%) had moderate suspicion, and 35 neonates (23.3%) had low suspicion. Mean NRBC counts increased with the severity of clinical suspicion, measuring approximately 474/mm³ in low suspicion cases, 2000/mm³ in moderate suspicion cases, and 8028/mm³ in high suspicion cases.

Table 1: Clinical Suspicion of Sepsis (n = 150)

Clinical Suspicion	Frequency (n)	Percentage (%)	Mean NRBC/cumm
Low	35	23.3	474
Moderate	23	15.3	2000
High	92	61.3	8028
Total	150	100.0	-

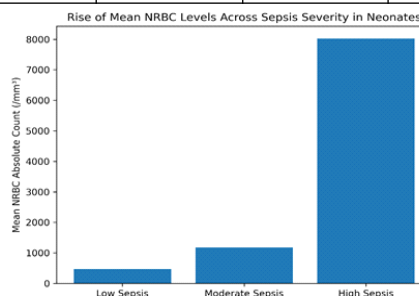


Figure 1: Distribution of Clinical Sepsis Suspicion (n = 150)

Ventilatory Support

Sixty neonates (40%) required ventilatory support. The mean NRBC count was significantly higher in ventilated neonates ($\approx 7500/\text{mm}^3$) compared with non-ventilated neonates ($\approx 2074/\text{mm}^3$), indicating a strong association between elevated NRBC levels and disease severity.

Table 2: Requirement of Ventilatory Support (n = 150)

Ventilation	Frequency (n)	Percentage (%)	meanNRBC/cumm
No	90	60%	2074
Yes	60	40%	7500
Total	150	100.0	-

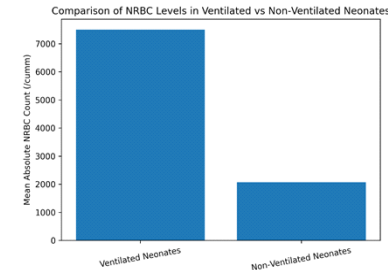


Figure 2: Distribution According to Ventilation Requirement (n = 150)

Inotropic Support

Among the 150 neonates, 54 (36%) required inotropic support, while 96 (64%) did not require inotropes. Neonates receiving inotropes demonstrated higher mean NRBC counts ($\approx 2500/\text{mm}^3$) compared with those without inotropic support ($\approx 1650/\text{mm}^3$).

Table 3: Requirement of Inotropic Support (n = 150)

Inotrope Support	Frequency (n)	Percentage (%)	NRBC/cumm
No	96	64.0	1650/cumm
Yes	54	36.0	2500/cumm
Total	150	100.0	-

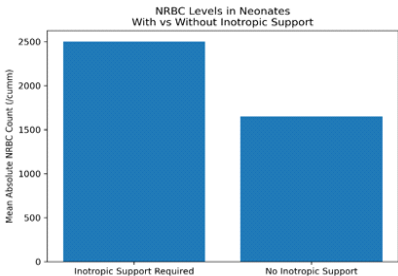


Figure 3: Distribution According to Inotrope Requirement (n = 150)

Final Diagnosis

Among the neonates studied, 72 (48.0%) had proven sepsis, 43 (28.7%) had probable sepsis, and 35 (23.3%) had no sepsis.

Association Between NRBC Elevation and Final Diagnosis

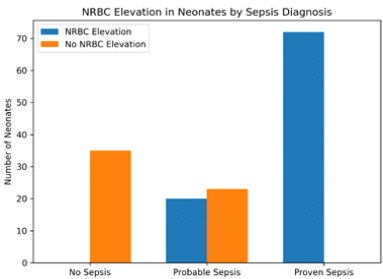
NRBC elevation was observed in 92 neonates (61.3%). All neonates with proven sepsis showed NRBC elevation, whereas none of the neonates without sepsis demonstrated elevated NRBC levels. In probable sepsis cases, 20 neonates showed NRBC elevation while 23 did not. The association between NRBC elevation and final diagnosis was statistically highly significant ($\chi^2 = 150.0$, $df = 2$, $p < 0.001$).

The calculated sensitivity and specificity of NRBC elevation for detecting neonatal sepsis were 60.3% and 100%, respectively.

Table 4: Association Between Final Diagnosis and NRBC Elevation (n = 150)

Final Diagnosis	NRBC No	NRBC Yes	Total
No Sepsis	35	0	35
Probable Sepsis	23	20	43
Proven Sepsis	0	72	72
Total	58	92	150

Figure 4: Relationship Between Final Diagnosis and NRBC Elevation



DISCUSSION

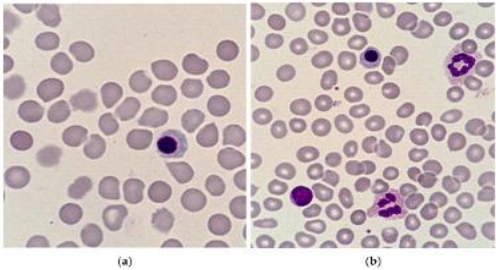


Figure: Nucleated red blood cells (NRBCs)

The present study demonstrated a strong association between NRBC elevation and neonatal sepsis. Elevated NRBC counts were consistently observed in neonates with proven sepsis and were absent in neonates without sepsis, highlighting their high diagnostic specificity.

The appearance of NRBCs in peripheral circulation is thought to result from systemic hypoxia and inflammatory cytokine release during sepsis. These factors stimulate erythropoietin production and accelerate bone marrow erythropoiesis, leading to premature release of NRBCs into the bloodstream.

In the present study, higher NRBC counts were associated with markers of severe illness such as requirement for ventilatory support and inotropic therapy. This finding suggests that NRBC levels may also serve as a prognostic indicator reflecting disease severity in neonatal sepsis.

Previous studies have also demonstrated similar findings, indicating that NRBC counts correlate with infection severity, systemic hypoxia, and adverse outcomes in neonates.

CONCLUSION

NRBC elevation shows a strong association with neonatal sepsis and correlates with disease severity. Due to its high specificity and accessibility through routine blood investigations, NRBC estimation can serve as a simple, cost-effective, and readily available adjunctive marker for early diagnosis assessment of neonatal sepsis, particularly in resource-limited settings.

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