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Original Research Article

THROMBOCYTOPENIA AND PLATELET INDICES AS PROGNOSTIC MARKERS IN NEONATAL SEPSIS: A PROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background: Neonatal sepsis is frequently complicated by hematological disturbances, particularly thrombocytopenia. Platelet indices (MPV, PDW, PCT) may serve as early biomarkers of sepsis severity and outcomes. The objective is to evaluate the prevalence of thrombocytopenia, analyze platelet indices in neonatal sepsis, and correlate these parameters with disease severity and mortality. **Materials and Methods:** This prospective observational study compared 40 septic neonates (culture-proven/clinical sepsis) with 40 healthy controls at a tertiary NICU (January 2017 to December 2018). Complete blood counts with platelet indices were analyzed using automated hematology analyzers. Statistical analysis included t-tests, chi-square tests, and correlation analyses (SPSS 26). **Result:** Thrombocytopenia (<150,000/µL) occurred in 80% of septic neonates (vs. 0% controls; p<0.001), with 15% having severe thrombocytopenia (<50,000/µL). Higher MPV (10.5±1.8fL vs. 8.2±1.1fL; p<0.001) and PDW (16.4±3.2% vs. 12.1±2.5%; p<0.001) in sepsis. Lower PCT in sepsis (0.18±0.07% vs. 0.25±0.09%; p=0.003). Severe thrombocytopenia correlated with 50% mortality (vs. 8.3% in mild cases; p<0.01). **Conclusion:** Thrombocytopenia and altered platelet indices (↑MPV/PDW, ↓PCT) are hallmark features of neonatal sepsis, with severe thrombocytopenia predicting poor outcomes. These parameters may enhance early risk stratification and guide clinical management.

INTRODUCTION

Neonatal sepsis remains a major global health concern and a leading cause of morbidity and mortality, particularly in preterm and low-birth-weight infants. It is estimated to affect 1 to 8 per 1,000 live births in developed countries and even higher in low-resource settings, where the burden of infection-related neonatal deaths is substantial.[1] Despite advancements in neonatal care, early diagnosis and effective management of sepsis remain challenging due to nonspecific clinical presentations and the lack of a definitive gold-standard diagnostic test.[2]

Hematological abnormalities, particularly thrombocytopenia, are commonly observed in septic neonates, with reported incidences ranging from 35% to 70%.[3] Thrombocytopenia in neonatal sepsis occurs due to increased platelet consumption, immune-mediated destruction, and impaired platelet production as a consequence of systemic inflammation.[4] Studies suggest that the severity and persistence of thrombocytopenia may correlate with poor clinical outcomes, including prolonged intensive care unit stays and increased mortality risk.[5]

In recent years, platelet indices, including mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT), have been investigated as potential biomarkers for sepsis severity and prognosis. Elevated MPV and PDW suggest increased platelet activation and heterogeneity, while a reduced PCT reflects a decline in overall platelet mass.[6] These indices may serve as cost-effective and readily available tools to support early risk stratification and guide clinical decision-making in neonatal sepsis.[7]

Given the potential diagnostic and prognostic value of platelet indices in sepsis, this study aimed to assess the prevalence and patterns of thrombocytopenia and platelet indices in neonates with sepsis. Additionally, we sought to explore their correlation with clinical outcomes to determine their utility as predictive markers in neonatal intensive care settings.

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MATERIALS AND METHODS

Study Design: This was a prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of from January 2017 to December 2018. The study aimed to evaluate thrombocytopenia and platelet indices (MPV, PDW, PCT) in neonates with sepsis and compare them with healthy controls.

Inclusion Criteria

Cases (Sepsis Group, n=40):

- Neonates (0–28 days) diagnosed with clinically suspected or culture-proven sepsis based on modified Neonatal Sepsis Score (NSS) and hematological markers (CRP, procalcitonin, IT ratio).
- Blood culture positivity was recorded but not mandatory for inclusion.

Controls (Healthy Neonates, n=40): Age-matched healthy neonates with no signs of infection, normal CBC, and no maternal risk factors (e.g., chorioamnionitis, PROM).

Exclusion Criteria

- Congenital malformations
- Perinatal asphyxia (Apgar <5 at 5 min)
- Maternal immune thrombocytopenia (ITP) or gestational thrombocytopenia
- Neonates on anticoagulant therapy

Sample Collection & Laboratory Methods

Blood Sampling

- 2 mL venous blood collected in EDTA tubes for:
  - Complete Blood Count (CBC) – Analyzed using an automated hematology analyzer (e.g., Sysmex XN-1000).
  - Platelet Indices:
    - ❖ Mean Platelet Volume (MPV, fL)
    - ❖ Platelet Distribution Width (PDW, %)
    - ❖ Plateletcrit (PCT, %)
- Blood culture (BACTEC system) for sepsis confirmation.

Definitions: Thrombocytopenia: Platelet count <150,000/µL

- Mild: 100,000–150,000/µL
- Moderate: 50,000–99,000/µL
- Severe: <50,000/µL

Sepsis: Based on clinical signs (respiratory distress, lethargy, temperature instability) + at least 2 abnormal lab markers (CRP >10 mg/L, IT ratio >0.2, leukopenia/leukocytosis).

Statistical Analysis

Software: SPSS v26.0 / MedCalc

Descriptive Statistics: Mean ± SD (parametric) or median [IQR] (non-parametric).

Comparative Tests:

- Student's t-test / Mann-Whitney U test (for continuous variables).
- Chi-square / Fisher's exact test (for categorical variables).

Correlation Analysis: Pearson / Spearman's test (platelet indices vs. outcomes).

p-value <0.05 considered statistically significant.

RESULTS

Table 1: Demographic and Clinical Characteristics.

Parameter	Sepsis Group (n=40)	Control Group (n=40)	p-value
Gestational Age (weeks)	34.2 ± 3.1	36.5 ± 2.8	0.002*
Birth Weight (g)	2150 ± 540	2850 ± 620	<0.001*
Male/Female	22/18	20/20	0.65
Preterm (%)	28 (70%)	10 (25%)	<0.001*
Culture-Positive Sepsis	24 (60%)	-	-

Table 2: Platelet Count and Indices in Sepsis vs. Control Groups

Parameter	Sepsis Group (n=40)	Control Group (n=40)	p-value
Platelet Count (×10³/µL)	98 ± 45	280 ± 75	<0.001*
MPV (fL)	10.5 ± 1.8	8.2 ± 1.1	<0.001*
PDW (%)	16.4 ± 3.2	12.1 ± 2.5	<0.001*
PCT (%)	0.18 ± 0.07	0.25 ± 0.09	0.003*

(MPV: Mean Platelet Volume; PDW: Platelet Distribution Width; PCT: Plateletcrit)

Table 3: Severity of Thrombocytopenia in Septic Neonates

Platelet Count (×10³/µL)	Number of Neonates (n=40)	Mortality Rate (%)
Normal (>150)	8 (20%)	0%
Mild (100-150)	12 (30%)	8.3%
Moderate (50-99)	14 (35%)	21.4%
Severe (<50)	6 (15%)	50%*

*($p < 0.001$ for severe thrombocytopenia vs. other groups)

Table 4: Correlation of Platelet Indices with Sepsis Outcomes

Parameter	Culture-Positive (n=24)	Culture-Negative (n=16)	p-value
MPV (fL)	11.2 ± 1.9	9.5 ± 1.6	0.008*
PDW (%)	17.6 ± 3.4	14.8 ± 2.9	0.012*
PCT (%)	0.15 ± 0.06	0.21 ± 0.08	0.023*

(Higher MPV and PDW, lower PCT in culture-positive sepsis)

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DISCUSSION

Our study demonstrates a high prevalence of thrombocytopenia (80%) in neonatal sepsis, with 15% of cases showing severe thrombocytopenia (<50,000/μL). These findings align with previous reports documenting thrombocytopenia in 35-70% of septic neonates.[8,9] The severity-based stratification revealed a clear mortality gradient, with 50% mortality in severe thrombocytopenia versus 8.3% in mild cases, reinforcing platelets' prognostic value in neonatal sepsis.[10]

The significantly elevated MPV (10.5 vs 8.2fL) and PDW (16.4% vs 12.1%) in septic neonates suggest increased platelet activation and heterogeneity, likely due to inflammatory cytokine release (IL-6, TNF-α).[11,12] Conversely, reduced PCT (0.18% vs 0.25%) indicates impaired thrombopoiesis, possibly from bone marrow suppression or consumptive coagulopathy.[13] These changes were more pronounced in culture-positive sepsis (MPV 11.2fL, PDW 17.6%), suggesting platelet indices may help differentiate septicemic from clinical sepsis.

The strong association between severe thrombocytopenia and mortality (50% vs 21.4% in moderate cases) supports using platelet counts for risk stratification.[14] The elevated MPV/PDW with low PCT pattern could serve as an early warning sign before overt thrombocytopenia develops.[15] This may guide decisions on antibiotic escalation or platelet transfusion in borderline cases.

CONCLUSION

The conclusion of this study reinforces the critical role of thrombocytopenia and altered platelet indices as significant biomarkers in neonatal sepsis. Our findings indicate that thrombocytopenia is present in a substantial proportion (80%) of neonates diagnosed with sepsis, with a remarkable association between severe thrombocytopenia and mortality, where 50% of these neonates succumbed to the condition. Elevated MPV and PDW, alongside decreased PCT, are distinctive features that may serve as early indicators of sepsis severity and predict adverse outcomes. These results underscore the importance of using platelet indices not only to confirm the presence of sepsis but also as reliable prognostic tools to guide clinical decision-making.

From a practical standpoint, integrating platelet indices into routine diagnostic protocols for neonates suspected of sepsis could significantly improve early detection and intervention. Specifically, MPV and PDW could be monitored as part of an early-warning system, allowing clinicians to escalate antibiotic treatment or initiate platelet transfusions before severe thrombocytopenia develops. Moreover, the use of these platelet indices in neonates with borderline or mild thrombocytopenia could enhance risk stratification, facilitating better management strategies to reduce mortality and morbidity rates. Given that these parameters are readily available and inexpensive to measure, they provide a practical, cost-effective approach for resource-limited settings, making them invaluable in neonatal intensive care units (NICUs), especially where more complex and expensive diagnostic tools might be unavailable.

Furthermore, these findings highlight the need for standardized protocols to guide clinical management based on platelet indices. Hospitals and NICUs should consider adopting protocols that incorporate the monitoring of platelet indices as part of the sepsis diagnostic and prognostic workup. This would enable clinicians to tailor interventions more effectively, particularly in high-risk groups, such as preterm or low-birth-weight neonates, who are more prone to sepsis-related complications. Additionally, future research should focus on multicenter, longitudinal studies with larger cohorts to further validate the predictive power of platelet indices, including tracking their changes over time to assess their role in disease progression. Such studies could lead to the development of refined, evidence-based guidelines for managing neonatal sepsis, enhancing outcomes across diverse healthcare settings.

Thrombocytopenia and altered platelet indices are pivotal in the early diagnosis and management of neonatal sepsis. Their incorporation into clinical practice, especially in high-risk neonates, promises to improve prognosis and reduce mortality, offering a more personalized and proactive approach to neonatal care. By emphasizing platelet indices as key markers for both early detection and risk assessment, healthcare systems worldwide can better address the challenges of neonatal sepsis, ultimately improving survival rates and long-term health outcomes for these vulnerable infants.

Limitations and recommendations

Single-center design may limit generalizability. Lack of serial measurements prevents tracking dynamic changes. Future multicenter studies with larger cohorts and longitudinal monitoring could validate these findings. Single-center design may limit generalizability. Lack of serial measurements prevents tracking dynamic changes. Future multicenter studies with larger cohorts and longitudinal monitoring could validate these findings.

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