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A STUDY TO ASSESS EFFECT ON PLATELET AND PLATELET INDICES IN NEONATAL SEPSIS

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ABSTRACT

Aims and objectives : To assess whether Platelet Parameters: Total platelet count (TPC), Mean platelet volume (MPV), Platelet distribution width (PDW)and the ratio of MPV/TPC can serve as diagnostic markers in neonatal sepsis

Materials and method: This observational study was conducted in the Department of Paediatrics at Maharshi Markandeshwar Institute of Medical Sciences and Research, Mullana, District Ambala, Haryana, over a period of one year and six months from April 2024 to October 2025. The study population comprised of 150 neonates diagnosed with sepsis and admitted to the neonatal unit during the study period. Convenience sampling was employed to recruit eligible participants. Blood samples were collected under strict aseptic precautions at the time of sepsis evaluation. Complete blood count, including platelet count and platelet indices, was performed simultaneously with blood culture sampling. Peripheral blood smear examination and C-reactive protein (CRP) estimation were performed for all neonates, with CRP levels >1 mg/L considered indicative of neonatal sepsis. An absolute neutrophil count (ANC) <1500/mm³ was considered abnormal. Blood cultures were processed according to standard microbiological protocols, while additional investigations, including cerebrospinal fluid culture, urine culture, and other body fluid cultures, were carried out whenever clinically indicated. Neonates aged less than 28 days at the time of admission who had either a positive sepsis screen or culture-proven sepsis were included in the study. Neonates and mothers with hematological disorders, neonates with major congenital anomalies or chromosomal disorders, and neonates born to mothers receiving antiplatelet medications were excluded.

Results: Platelet count was significantly lower in fungal sepsis (p value 0.041), while platelet distribution width (PDW) (p value 0.01) and the mean platelet volume/platelet count (MPV/TPC) ratio (p value 0.004) were significantly higher in fungal sepsis .MPV/TPC ratio demonstrated the highest diagnostic accuracy for predicting mortality (AUC = 0.918), followed by PDW (AUC = 0.872) and platelet count (AUC = 0.868), whereas MPV showed the best predictive ability for the onset of sepsis EONS vs LONS (AUC = 0.732). PDW and MPV/TPC were more significantly elevated than thrombocytopenia and MPV in fungal sepsis. Acinetobacter baumannii featured as most common cause of sepsis in both early-onset neonatal sepsis (EONS) and late-onset neonatal sepsis (LONS) . Candida albicans appearing as a cause of EONS further warns antibiotic stewardship as the need of the hour.

Conclusion: Platelet indices, particularly mean platelet volume (MPV), platelet distribution width (PDW), and the MPV/platelet count (MPV/TPC) ratio, are simple, rapid, inexpensive, and readily available biomarkers that may serve as useful adjuncts in the diagnosis and prognostication of neonatal sepsis when interpreted alongside clinical assessment and other laboratory findings.

INTRODUCTION

Sepsis is a major global cause of morbidity and mortality, with neonatal sepsis constituting a life-threatening systemic inflammatory response to bloodstream infections during the first 28 days of life, largely due to the immaturity of the neonatal immune system.[1] It remains the second leading cause of neonatal death worldwide, accounting for over one million deaths annually, with India reporting one of the highest incidences and case fatality rates.[2]

Neonatal sepsis may be caused by bacterial, viral, fungal, or protozoal pathogens and can manifest as septicemia, pneumonia, meningitis, osteomyelitis, septic arthritis, or urinary tract infections. It is characterized by clinical signs of infection with or without bacteremia and is often associated with positive blood cultures, thrombocytopenia, elevated C-reactive protein levels, and serious complications such as septic shock.[2,3]

Thrombocytopenia is a frequent hematological abnormality in neonatal sepsis and an important independent predictor of sepsis-related mortality, arising from increased platelet destruction and consumption that exceed platelet production due to endothelial injury and reticuloendothelial activation.[4] Although microbial isolation from blood, cerebrospinal fluid, or urine remains the gold standard for diagnosis, its limited sensitivity and delayed results necessitate the identification of rapid and reliable biomarkers for early detection.[5]

Platelet indices, including platelet count, mean platelet volume (MPV), and platelet distribution width (PDW), are readily available, inexpensive, and rapidly obtained from routine complete blood count analysis, making them attractive diagnostic tools. While several studies have reported their potential role as early diagnostic and prognostic markers of neonatal sepsis, inconsistent findings and limited evidence regarding their ability to differentiate culture-positive from culture-negative sepsis warrant further investigation.[6-8] Therefore, the present study was undertaken to assess alterations in platelet count and platelet indices in neonatal sepsis and to evaluate their usefulness as early, economical, and dependable diagnostic markers in a tertiary care neonatal intensive care unit.

MATERIAL AND METHODS

This observational study was conducted in the Department of Paediatrics at Maharshi Markandeshwar Institute of Medical Sciences and Research, Mullana, District Ambala, Haryana, over a period of one year and six months from April 2024 to October 2025. The study population comprised neonates diagnosed with sepsis and admitted to the neonatal unit during the study period. Convenience sampling was employed to recruit eligible participants. Neonates aged less than 28 days at the time of admission who had either a positive sepsis screen or culture-proven sepsis were included in the study. Neonates and mothers with hematological disorders, neonates with major congenital anomalies or chromosomal disorders, and neonates born to mothers receiving antiplatelet medications were excluded. Ethical clearance was obtained from the Institutional Review Board of Maharshi Markandeshwar Institute of Medical Sciences and Research prior to the initiation of the study. Written informed consent was obtained from the parents or legal guardians of all enrolled neonates after explaining the objectives and procedures of the study.

Relevant socio-demographic details, including age and gender of the neonates, were recorded. Obstetric information such as gestational age at delivery and mode of delivery, along with neonatal parameters including birth weight and APGAR scores, were documented from clinical records. Blood samples were collected under strict aseptic precautions at the time of sepsis evaluation. Complete blood count, including platelet count and platelet indices, was performed simultaneously with blood culture sampling. The cut-off values adopted for platelet indices were platelet count <1.5 lakh/mm³, mean platelet volume (MPV) >10.8 fL, and platelet distribution width (PDW) >19.1 fL, based on previously published studies. Peripheral blood smear examination and C-reactive protein (CRP) estimation were performed for all neonates, with CRP levels >1 mg/L considered indicative of neonatal sepsis. An absolute neutrophil count (ANC) <1500/mm³ was considered abnormal. Blood cultures were processed according to standard microbiological protocols, while additional investigations, including cerebrospinal fluid culture, urine culture, and other body fluid cultures, were carried out whenever clinically indicated. All relevant clinical and laboratory data were systematically recorded in a predesigned proforma and subsequently entered into a database for analysis.

Statistical Analysis

The collected data were entered into Microsoft Excel and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation (SD) or median with interquartile range (IQR), whereas categorical variables were presented as frequencies and percentages. Comparisons between groups were performed using the Independent t-test, Chi-square test, and Analysis of Variance (ANOVA), as appropriate. Receiver Operating Characteristic (ROC) curve analysis was conducted to evaluate the diagnostic accuracy of platelet indices, and binary logistic regression analysis was performed to identify independent predictors of neonatal sepsis. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Table 1. Baseline Characteristics, Clinical Profile, Laboratory Parameters, and Outcomes of Study Participants (N = 150)

Variable	Category	Frequency (n)	Percentage (%)
1. Place of Birth	Inborn Outborn	114 36	76.0 24.0

2. Gestational Age	<28 weeks 28–31+6 weeks 32–33+6 weeks 34–36+6 weeks ≥37 weeks	4 28 35 33 50	2.7 18.7 23.3 22.0 33.3
3. Birth Weight (g)	<1000 1001–1499 1500–2500 >2500	4 35 75 36	2.7 23.3 50.0 24.0
	Mean ± SD	1.99 ± 0.665 kg	—
4. Age of Onset of Sepsis	EONS (≤72 hours) LONS (>72 hours)	58 92	38.7 61.3
5. Gender	Female Male	63 87	42.0 58.0
6.Maternal Risk Factors	PROM Maternal UTI Maternal Fever	60 39 54	40.0 26.0 36.0
7. Mode of Delivery	Caesarean Section Normal Vaginal	84 66	56.0 44.0
8. CRP Status	Positive Negative	88 62	58.7 41.3
9. ANC	<1500/mm³ ≥1500/mm³	53 97	35.3 64.7
10. Platelet Count	<1.5 lakh/mm³ ≥1.5 lakh/mm³	132 18	88.0 12.0
	Median (IQR)	1.18 (0.838–1.420)	—
11. MPV	>10.8 fL ≤10.8 fL	101 49	67.3 32.7
	Median (IQR)	11.33 (10.577–12.162)	—
12. PDW	>19.1 fL ≤19.1 fL	113 37	75.3 24.7
	Median (IQR)	20.165 (19.100–21.140)	—
13. MPV/Platelet Count Ratio	≤10 >10	22 128	14.7 85.3
	Median (IQR)	9.477 .795–14.228)	—
14. Type of Sepsis	Culture Proven Clinical Sepsis	63 87	42.0 58.0
15. ICU Stay	≤10 days >10 days	112 38	74.7 25.3
	Median (IQR)	8 (5–11) days	—
16. Neonatal Outcome	Survivor Non-survivor	125 25	83.3 16.7

A total of 150 neonates with sepsis were included in the study. Most neonates were inborn (76.0%), while 24.0% were outborn. With respect to gestational age, 33.3% were born at term (≥37 weeks), whereas 66.7% were preterm. The largest proportion of neonates belonged to the 32–33+6 weeks gestational age group (23.3%). The mean birth weight was 1.99 ± 0.665 kg, and half of the neonates (50.0%) had a birth weight between 1500 and 2500 g.

Late-onset neonatal sepsis was more common than early-onset neonatal sepsis, accounting for 61.3% and 38.7% of cases, respectively. Male neonates constituted 58.0% of the study population, while females accounted for 42.0%. Among maternal risk factors, premature rupture of membranes was the most frequently observed (40.0%), followed by maternal fever (36.0%) and maternal urinary tract infection (26.0%). Caesarean section was the mode of delivery in 56.0% of cases.

Laboratory findings showed that 58.7% of neonates had a positive CRP status, while 35.3% had an absolute neutrophil count below 1500/mm³. Thrombocytopenia was highly prevalent, with 88.0% of neonates having a platelet count below 1.5 lakh/mm³. The median platelet count was 1.18 lakh/mm³ (IQR: 0.838–1.420). Elevated platelet indices were frequently observed, with 67.3% of neonates demonstrating an MPV greater than 10.8 fL and 75.3% showing a PDW greater than 19.1 fL. In addition, 85.3% of neonates had an MPV/platelet count ratio greater than 10.

Clinical sepsis accounted for 58.0% of cases, whereas 42.0% were culture-proven sepsis. Most neonates (74.7%) had an ICU stay of 10 days or less, with a median ICU stay of 8 days (IQR: 5–11 days). The survival rate was 83.3%, while 16.7% of neonates did not survive, indicating a considerable burden of morbidity and mortality associated with neonatal sepsis.

Table 2: Organism Of Sepsis Among Study Participants

Category	**Microorganism**	**EONS n (%)**	**LONS n (%)**	**Total n (%)**
Gram-negative	Acinetobacter baumannii	9 (15.5)	14 (15.2)	23 (15.3)
	Burkholderi acepacia	0 (0.0)	1 (1.1)	1 (0.7)
	E. coli	1 (1.7)	2 (2.2)	3 (2.0)
	Klebsiella pneumoniae	6 (10.3)	5 (5.4)	11 (7.3)
	Pseudomonas aeruginosa	1 (1.7)	0 (0.0)	1 (0.7)
	Serratia marcescens	3 (5.2)	1 (1.1)	4 (2.7)
Gram-positive	Enterococcus faecalis	0 (0.0)	2 (2.2)	2 (1.3)
	MRSA	1 (1.7)	0 (0.0)	1 (0.7)
	Staphylococcus epidermidis	1 (1.7)	1 (1.1)	2 (1.3)
Fungal	Candida albicans	5 (8.6)	1 (1.1)	6 (4.0)
	Candida kruseii	1 (1.7)	2 (2.2)	3 (2.0)
	Candida pelliculosa	1 (1.7)	5 (5.4)	6 (4.0)
Clinical sepsis		29 (50.0)	58 (63.0)	87 (58.0)
Total		**58**	**92**	**150 (100)**

Among the 150 neonates with sepsis, 58 (38.7%) had early-onset sepsis (EONS) and 92 (61.3%) had late-onset sepsis (LONS). Clinical sepsis was the most common diagnosis, accounting for 58.0% of all cases, and was more frequently observed in LONS (63.0%) than EONS (50.0%).

Among culture-positive cases, Gram-negative organisms predominated, with *Acinetobacter baumannii* being the most frequently isolated pathogen (15.3%), followed by *Klebsiella pneumoniae* (7.3%). Fungal infections constituted 10.0% of isolates, with *Candida albicans* and *Candida pelliculosa* each accounting for 4.0% of cases. Gram-positive organisms were relatively uncommon, contributing to only 3.3% of total cases. Overall, Gram-negative bacteria emerged as the predominant causative organisms of neonatal sepsis in the study population.

Table.3: Comparison of Platelet Count and Platelet Indices According to Type of Organism, Neonatal Outcome, Onset of Sepsis, and Type of Sepsis

Variable	Category	Platelet Count (Mean±SD)	MPV (Mean±SD)	PDW (Mean±SD)	MPV/Platelet Count (Mean±SD)
Type of Organism	Gram Positive Gram Negative Fungal Clinical	1.32±0.315 1.08±0.376 0.95±0.306 1.18±0.323	10.57±1.393 11.47±1.535 11.97±1.647 11.15±1.214	16.28±5.162 14.62±3.484 19.00±4.346 12.61±2.046	8.43±2.506 12.45±6.334 13.94±5.268 10.25±3.441
	p-value	0.041	0.088	<0.001	0.004
Neonatal Outcome	Non-Survivor Survivor	0.76±0.205 1.21±0.316	12.68±1.641 11.04±1.153	18.34±4.199 13.10±2.608	17.94±5.632 9.88±3.305
	p-value	<0.001	<0.001	<0.001	<0.001
Onset of Sepsis	EONS LONS	1.24±0.289 1.06±0.360	10.77±0.790 11.65±1.564	12.91±1.699 14.65±4.147	9.23±2.727 12.48±5.420
	p-value	0.002	<0.001	0.003	<0.001
Type of Sepsis	Culture-Proven Sepsis Clinical Sepsis	1.07±0.364 1.28±0.323	12.52±1.566 10.15±1.214	15.76±4.188 12.61±2.046	12.49±5.986 10.25±3.441
	p-value	<0.001	<0.001	<0.001	0.005

The comparison of platelet indices across different categories demonstrated significant variations. Based on the type of organism, platelet count was lowest in fungal sepsis (0.95 ± 0.306 lakh/mm³) and highest in gram-positive sepsis (1.32 ± 0.315 lakh/mm³) (p=0.041). PDW and MPV/platelet count ratio also differed significantly among organism groups (p<0.001 and p=0.004, respectively), with the highest values observed in fungal infections. However, MPV did not show a statistically significant difference according to the type of organism (p=0.088).

When neonatal outcomes were considered, non-survivors had significantly lower platelet counts (0.76 ± 0.205 vs. 1.21 ± 0.316 lakh/mm³) and significantly higher MPV (12.68 ± 1.641 vs. 11.04 ± 1.153 fL), PDW (18.34 ± 4.199 vs. 13.10 ± 2.608 fL), and MPV/platelet count ratio (17.94 ± 5.632 vs. 9.88 ± 3.305) compared with survivors (all p<0.001), indicating a strong association between abnormal platelet indices and mortality.

Late-onset neonatal sepsis was associated with significantly lower platelet counts and higher MPV, PDW, and MPV/platelet count ratio compared with early-onset neonatal sepsis (all p<0.01). Similarly, culture-proven sepsis demonstrated significantly lower platelet counts and higher MPV, PDW, and MPV/platelet count ratio than clinical sepsis (all p≤0.005). These findings suggest that thrombocytopenia and elevated platelet indices are associated with more severe disease, culture positivity, late-onset sepsis, and poorer neonatal outcomes.

Table.4: ROC Analysis of Platelet Indices for Different Clinical Outcomes

Platelet Index	Mortality AUC	Onset of Sepsis AUC	Type of Sepsis AUC
Platelet Count p-value	0.868 <0.001	0.642 0.003	0.592 0.045
PDW p-value	0.872 <0.001	0.631 0.007	0.576 0.112
MPV p-value	0.780 <0.001	0.732 <0.001	0.531 0.518
MPV/TPC p-value	0.918 <0.001	0.693 <0.001	0.585 0.075

ROC analysis demonstrated that all platelet indices had significant predictive ability for mortality, with the highest diagnostic accuracy observed for the MPV/platelet count ratio (AUC=0.918), followed by PDW (AUC=0.872), platelet count (AUC=0.868), and MPV (AUC=0.780) (all p<0.001). This indicates that the MPV/platelet count ratio was the strongest predictor of neonatal mortality.

For distinguishing early-onset from late-onset sepsis, MPV showed the best discriminative ability (AUC=0.732), followed by MPV/platelet count ratio (AUC=0.693), platelet count (AUC=0.642), and PDW (AUC=0.631), with all parameters demonstrating statistically significant predictive value. In contrast, the platelet indices showed poor discriminatory performance for differentiating culture-proven from clinical sepsis, with AUC values ranging from 0.531 to 0.592, indicating limited clinical utility for this purpose.

DISCUSSION

Neonatal sepsis remains a major cause of neonatal morbidity and mortality, particularly in developing countries, and is often difficult to diagnose early due to its nonspecific clinical presentation. Conventional diagnostic methods such as blood culture are time-consuming and have limited sensitivity, frequently resulting in empirical antibiotic therapy and associated complications.[9] Therefore, readily available hematological parameters, including platelet count and platelet indices such as MPV and PDW, are being investigated as rapid, cost-effective markers for predicting neonatal sepsis, which forms the basis of the present study.

The present study predominantly included inborn neonates (76%), similar to the observations of Islam et al.[10] (2024) and Bhakri et al.[11] (2017), with a higher proportion of preterm infants (53.3%), comparable to Bhakri et al.[11] (2017), Majumdar et al.[12] (2021), and Kaur et al.[13] (2024), supporting the increased susceptibility of preterm neonates to sepsis; additionally, late-onset neonatal sepsis (61.3%) was more prevalent than early-onset sepsis, contrasting with the findings of Bhakri et al.[11] (2017) and Islam et al.[10] (2024), and suggesting a greater contribution of hospital-related risk factors and prolonged neonatal care exposure.

The present study identified premature rupture of membranes (40%), maternal fever (36%), and maternal urinary tract infection (26%) as the most common maternal risk factors for neonatal sepsis, with the frequency of PROM being comparable to that reported by Bhakri et al.[11] (2017), highlighting the significant role of maternal infections in neonatal disease transmission. Cesarean section was the predominant mode of delivery (56%), consistent with the findings of Panda SK et al.[14] (2022) and Kaur et al.[13] (2024), whereas Bhakri et al.[11] (2017) reported a higher proportion of normal vaginal deliveries, suggesting that delivery patterns may vary according to institutional practices and maternal risk profiles. Furthermore, CRP was positive in 58.7% of cases, a finding comparable to Choudhary RR et al.[15] (2018) and higher than those reported by Bhakri et al.[11] (2017) and Karne et al.[3] (2017), supporting its value as a useful adjunctive marker for the early identification of neonatal sepsis when interpreted alongside clinical and laboratory findings.

The present study demonstrated thrombocytopenia in 88% of neonates and elevated MPV (>10.8 fL) in 67.3% of cases, indicating that reduced platelet count and increased platelet activation are common hematological alterations in neonatal sepsis. These findings are comparable to those reported by Gautam et al.[16] (2023), Choudhary RR et al. (2018),[15] Mohan et al. (2025),[8] and Niharika et al. (2024)[17], supporting the utility of platelet count and MPV as simple, cost-effective adjunctive markers for the diagnosis of neonatal sepsis.

In the present study, clinical sepsis (58%) was more common than culture-proven sepsis (42%), emphasizing the limitations of blood culture as a diagnostic tool and the continued importance of clinical assessment in the management of neonatal sepsis. Among culture-positive cases, gram-negative organisms predominated, with *Acinetobacter baumannii* being the most common isolate, followed by *Klebsiella pneumoniae* and *Escherichia coli*. Similar predominance of gram-negative pathogens has been reported by Panda SK et al.[14] (2022), Goyal et al. (2024),[18] and Bagchi et al.[19] (2023),), although variations in the predominant organism across studies likely reflect differences in local microbial epidemiology and hospital infection control practices. The majority of neonates (74.7%) required ICU stay of ≤10 days, while an overall survival rate of 83.3% was observed, indicating favorable outcomes despite the significant burden of neonatal sepsis.

A significant association was observed between platelet parameters and disease severity. Culture-proven sepsis, late-onset sepsis, and non-survivors demonstrated significantly lower platelet counts and higher MPV, PDW, and MPV/platelet count ratios compared to their counterparts. These findings are consistent with the observations of Mullaivendan et al. (2025),[20] Shaw et al. (2025),[9] Islam et al.[10] (2024) and Mittal et al.[21] (2018) who also reported thrombocytopenia and elevated platelet indices in severe neonatal sepsis and adverse outcomes. ROC analysis further revealed that the MPV/platelet count ratio had the highest predictive accuracy for mortality, followed by PDW and platelet count, supporting their role as useful prognostic markers. Collectively, these findings suggest that platelet indices, being inexpensive and routinely available hematological parameters, may serve as valuable adjuncts for early diagnosis, risk stratification, and prognostication in neonatal sepsis, particularly in resource-limited settings.

Overall, the findings of the present study highlight the significant association of thrombocytopenia and altered platelet indices with neonatal sepsis, particularly in culture-proven sepsis, late-onset sepsis, and adverse clinical outcomes. The observed diagnostic and prognostic utility of platelet count, MPV, PDW, and especially the MPV/platelet count ratio suggests that these readily available hematological parameters can complement conventional sepsis markers and aid in the timely identification and management of neonatal sepsis.

CONCLUSION

Neonatal sepsis continues to be a significant cause of neonatal morbidity and mortality, particularly among preterm and low-birth-weight infants. The present study demonstrated that thrombocytopenia and elevated platelet indices, especially MPV, PDW, and MPV/platelet count ratio, were significantly associated with culture-proven sepsis, late-onset sepsis, and poor clinical outcomes. Among the evaluated parameters, the MPV/platelet count ratio showed the highest predictive accuracy for mortality, while MPV was the best predictor of sepsis onset. These findings suggest that platelet indices are simple, rapid, inexpensive, and readily available adjunctive biomarkers that can aid in the diagnosis and prognostication of neonatal sepsis when used alongside clinical and laboratory assessment.

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