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Evaluation of Platelet and its Indices as Markers of Neonatal Sepsis

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Abstract: ***Introduction: Neonatal sepsis is a leading cause of morbidity and mortality in neonates, particularly in developing countries. Early diagnosis is challenging due to the nonspecific clinical presentation and the limitations of conventional diagnostic methods such as blood culture. Platelet indices, including mean platelet volume (MPV), platelet distribution width (PDW), have emerged as potential biomarkers for neonatal sepsis due to their role in inflammation and immune response. Objectives: 1) To evaluate platelet and its indices as markers of neonatal sepsis. 2) To compare the platelet indices (platelet count, MPV, PDW) in early and late onset sepsis. Methods: This prospective observational study included neonates diagnosed with sepsis. Platelet count and indices were measured on day 1, day 3, and day 5 of illness. Neonates were categorized based on type of sepsis onset (early or late). Statistical analyses were performed to assess differences in platelet indices between these groups. Results: Among 150 neonates, early - onset sepsis was more prevalent (57.3%). Platelet count was significantly lower in neonates with Late - onset sepsis compared to early - onset sepsis (p = 0.004). MPV and PDW were significantly elevated in septic neonates reflecting increased platelet activation during sepsis. Serial measurements showed a progressive decline in platelet count and dynamic changes in platelet indices over time. Conclusion: Platelet indices, particularly MPV and PDW, demonstrate potential as adjunctive markers for the early diagnosis and monitoring of neonatal sepsis. Their routine assessment, along with conventional biomarkers, could improve early identification and guide timely intervention.***

Keywords: Neonatal sepsis, Platelet indices, Mean platelet volume, Platelet distribution width, Biomarkers, Neonatal infection

1. Introduction

Neonatal sepsis is a significant cause of morbidity and mortality in neonates, particularly in developing countries. It is a systemic inflammatory response to infection in the bloodstream, which can affect multiple organs and lead to severe complications. Neonatal sepsis can present with subtle signs such as feeding intolerance, lethargy, and abnormal temperature, making it difficult to distinguish from other conditions that may mimic the symptoms of sepsis. [1]

Platelet count and indices, such as mean platelet volume (MPV), platelet distribution width (PDW), have been studied in various infectious and inflammatory conditions, including neonatal sepsis. The alteration of platelet function and morphology during infection shows that platelet indices could serve as an adjunctive marker in diagnosing sepsis and monitoring its progression. [2]

Platelets are traditionally known for their role in blood clotting, but Ali et al study [3]. have revealed their significant involvement in the immune response, particularly in the context of infections

Platelet indices, including MPV, PDW, are routinely measured in automated complete blood count (CBC) tests, which are widely available in clinical practice. Saran et al. study have shown that alterations in platelet indices are frequently observed in neonates with sepsis, suggesting their potential role in the early identification of the condition. [4]

2. Materials and Methods

Study Design: This was a prospective observational study conducted in the Neonatal Intensive Care Unit (NICU) of the Department of Pediatrics in collaboration with the Department of Pathology at SIMS, Hapur.

Study Population - The study included all neonates with proven sepsis admitted to the NICU.

Study Period - The study was carried out from May 2023 to April 2025.

Sample Size - A total of 150 neonates with sepsis were included in the study.

Inclusion Criteria

Neonates fulfilling any of the following criteria were included:

1) Neonates admitted to the hospital showing signs and symptoms of sepsis such as apnea, abdominal distension, refusal to feed, increased pre - feed aspirates, tachycardia, hypothermia, chest retractions, lethargy, and grunting.
2) Neonates born to mothers with risk factors for sepsis.
3) Neonates with a positive sepsis screen and/or culture - confirmed sepsis.
4) Neonates whose parents have given written and informed consent.

Exclusion Criteria

Neonates with congenital or acquired causes of thrombocytopenia were excluded, including those with:

1) Placental insufficiency
2) Maternal preeclampsia
3) Neonatal alloimmune thrombocytopenia (NAIT)
4) Thrombosis

3. Methodology

- Platelet indices were measured on the first, third, and fifth days of illness.
- Data were entered into Microsoft Excel and analyzed using SPSS Software version 29.
- Variables were expressed as mean ± standard deviation (SD), frequencies and percentages.
- Statistical tests such as the chi - square test and t - test were applied.
- A p - value < 0.05 was considered statistically significant.

4. Results

- 64.0% mothers were primiparous, while 36.0% were multiparous.
- Out of the total 150 newborns, 43.3% were female and 56.7% were male. The majority of deliveries were normal vaginal delivery (NVD) at 72.7%, while 27.3% were lower segment cesarean section (LSCS). In terms of gestational age, 66.7% of the newborns were preterm, and 33.3% were term.
- 57.3% of the newborns had early onset sepsis, while the majority 42.7% had late onset sepsis. This shows that early onset sepsis was more prevalent in the studied population.
- On Day 1 (PLT_D1), the early onset group had a mean platelet count of 167.78 ± 18.51, while the late onset group had a slightly lower mean platelet count of 153.69 ± 31.63. The difference between these groups was statistically significant with a p - value of 0.004.
- On Day 3 (PLT_D3), the early onset group showed a mean platelet count of 154.62 ± 23.22, and the late onset group had a lower count of 137.50 ± 29.37. This difference was also statistically significant with a p - value of 0.017.
- On Day 5 (PLT_D5), the early onset group had a mean platelet count of 165.2 ± 16.5, while the late onset group had a much lower mean count of 143.66 ± 32.88. The difference observed on Day 5 was highly significant, with a p - value of <0.001.
- On Day 1 (D1), the late onset group had a significantly higher MPV (10.44 ± 1.2 fL) compared to the early onset group (9.48 ± 0.82 fL). The overall p - value of <0.001 shows a highly significant difference between the two groups.
- On Day 3 (D3), the late onset group had an MPV of (11.31 ± 1.1 fL), which was again higher then the early onset group (10.26 ± 1.33 fL). The p - value of <0.001 confirms a significant difference between the two groups.
- On Day 5 (D5), the early onset group had an MPV of 9.86 ± 1.05 fL, while the late onset group had a higher MPV of 10.85 ± 1.30 fL. The p - value of <0.001 shows a statistically significant difference between the groups.
- On Day 1 (D1), the PDW is significantly higher in late onset group (13.02 ± 2.09) compared to early onset group (10.87 ± 1.81), with a p - value of <0.001, indicating a strong statistical difference.
- On Day 3 (D3), the PDW remains higher in the late onset group (13.30 ± 3.12) compared to the early onset group (10.88 ± 2.61), and the p - value is again <0.001, suggesting a significant difference.
- On Day 5 (D5), the late onset group continues to show a higher PDW (12.20 ± 2.58) than the early onset group (10.30 ± 1.62), with a p - value of <0.001, indicating a statistically significant difference.

Table 1: Total Platelet Count (×10³/µL) Based on Onset of Sepsis

Onset of Sepsis	PLT_D1	PLT_D3	PLT_D5
Early Onset	167.78 ± 18.51	154.62 ± 23.22	165.2 ± 16.5
Late Onset	153.69 ± 31.63	137.50 ± 29.37	143.66 ± 32.88
Total	161.8 ± 25.8	147.3 ± 27.3	157.0 ± 26.3
t value	11.7	15.8	35.3
p value	0.004	0.017	<0.001

Table 2: Mean Platelet Volume (MPV) (fL) Based on Onset of Sepsis

Onset of Sepsis	MPV_D1	MPV_D3	MPV_D5
Early Onset	9.48 ± 0.8	10.26 ± 1.3	9.86 ± 1.05
Late Onset	10.44 ± 1.2	11.31 ± 1.1	10.85 ± 1.30
Total	9.9 ± 1.1	10.7 ± 1.4	10.3 ± 1.3
t – test	32.5	25.3	26.4
p value	<0.001	<0.001	<0.001

Table 1: Platelet Distribution Width (PDW) (fL) Based on Onset of Sepsis

Onset of Sepsis	PDW_D1	PDW_D3	PDW_D5
Early Onset	10.87 ± 1.81	10.88 ± 2.61	10.30 ± 1.62
Late Onset	13.02 ± 2.09	13.30 ± 3.12	12.20 ± 2.58
Total	11.8 ± 2.2	11.9 ± 3.1	11.1 ± 2.3
t - test	44.9	26.5	30.5
p value	<0.001	<0.001	<0.001

5. Discussion

In our study, the total platelet count (PLT) showed a significant decline over time in neonates with Late - onset sepsis compared to those with Early - onset sepsis. On day 1, the mean platelet count in EOS cases was higher (167.78 ± 18.51 ×10³/µL) than in LOS cases (153.69 ± 31.63 ×10³/µL) (p = 0.004). This trend continued through day 3 (154.62 ± 23.22 ×10³/µL vs.137.50 ± 29.37 ×10³/µL, p = 0.017) and was most pronounced by day 5, where the mean platelet count in LOS cases was significantly lower (143.66 ± 32.88 ×10³/µL) compared to EOS cases (165.2 ± 16.5 ×10³/µL) (p < 0.001). These findings highlight the progressive thrombocytopenia seen in neonatal sepsis, with a more marked decrease in Late - onset cases.

Our findings align with previous studies, which report an overall decline in platelet counts during the course of sepsis. Muronoi et al. (2016) found that sepsis patients typically present with platelet counts within the normal range (≥80×10³/µL) at ICU admission, but a significant proportion develop thrombocytopenia as sepsis progresses. [5] Wang et al. (2022) defined normal platelet counts as ≥150×10³/µL and observed a decline in sepsis patients, similar to our study. [6] Zhou et al. (2021) reported that 18% of sepsis patients developed thrombocytopenia during their ICU stay, with 9.2% experiencing late - onset thrombocytopenia. [7] Notably, Schupp et al. (2022) found a nadir in platelet counts on day 5, with a mean decrease of 21.5% from baseline—consistent with our observation of the lowest platelet levels occurring on day 5. [8]

In our study, Mean Platelet Volume (MPV) showed a significant increase over time in both early - onset sepsis (EOS) and late - onset sepsis (LOS), but the values were consistently higher in LOS cases. These findings suggest that MPV is an important marker of platelet activation and inflammation, with more pronounced changes observed in Late - onset sepsis.

Our results align with previous research indicating that MPV is elevated in sepsis patients, reflecting increased platelet turnover and activation. Shaaban & Safwat (2018) reported that preterm infants with early - onset sepsis had significantly higher MPV values compared to non - septic neonates. [9] Similarly, Patrick & Lazarchick (1990) observed that neonates with early infection tended to have normal or slightly increased MPV, whereas those with late - onset infections exhibited a more pronounced MPV elevation. [10]

In our study, Platelet Distribution Width (PDW) was significantly higher in neonates with Late - onset sepsis (LOS) compared to those with Early - onset sepsis (EOS) across all three time points. On day 1, the mean PDW was 10.87 ± 1.81 fL in EOS, significantly lower than 13.02 ± 2.09 fL in LOS ($p < 0.001$). This trend persisted on day 3 (10.88 ± 2.61 fL vs.13.30 ± 3.12 fL, $p < 0.001$) and day 5 (10.30 ± 1.62 fL vs.12.20 ± 2.58 fL, $p < 0.001$). These findings suggest a more pronounced alteration in platelet morphology in LOS, likely reflecting a heightened inflammatory response.

Our results align with previous studies that highlight PDW as a potential marker for sepsis. Patrick & Lazarchick (1990) reported that neonates with late infection exhibited significant increases in MPV and PDW. [10] Their study also found that PDW values greater than 19.1% had high specificity (79%) for detecting bacteremia. Similarly, Karabulut & Arcagok (2019) found elevated PDW in neonates with suspected and confirmed EOS compared to healthy controls, reinforcing its potential as a sepsis biomarker. [11]

6. Conclusion

The evaluation of platelet count and its indices in neonatal sepsis provides valuable insights into their role as potential markers for early diagnosis and prognosis. The study observed variations in platelet count, mean platelet volume (MPV), and platelet distribution width (PDW) among neonates with early and late - onset sepsis, with statistically significant differences across different time points. A decreasing trend in platelet count was noted in septic neonates, particularly in those with Late - onset sepsis, suggesting its association with disease severity. Additionally, MPV and PDW were found to be elevated in septic neonates, highlighting their potential as indicators of platelet activation and consumption in response to infection.

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