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Mean Platelet Volume in Neonatal Sepsis: Evaluation of 140 Suspected Cases of Neonatal Sepsis

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ABSTRACT

Objective: To compare mean platelet volume in neonates with and without sepsis.
Study Design: Cross-sectional study.
Place and Duration of Study: Neonatal Intensive Care Unit, Pak Emirates Military Hospital, Rawalpindi Pakistan, from Jul 2017 to Jan 2018.
Methodology: A total of 140 neonates of either gender with ages between 0-28 days, suspected of neonatal sepsis presenting with any two of the signs: a core body temperature of >38.5°C or <36°C at time of presentation, pulse rate beyond the range of 100-200 beats/minute, leukocyte count beyond the range of 4000 to 30,000/mm^3 or >10% immature neutrophils on peripheral smear, tachypnea (>60 breaths/minute) and oxygen saturation (<90%) on the pulse oximeter, were included. Three ml of blood was drawn and sent for culture, while another 3ml of blood was sent for peripheral smear and mean platelet volume.
Results: There were 31 (22.14%) neonates who were culture positive for neonatal sepsis. The age distribution of the neonates showed that 43 (30.71%) were between 0-7 days, whereas 97 (69.29%) were between 8-28 days. The mean gestational age was noted to be 37.04±1.76 weeks. The mean neonatal birth weight was 2344.28±.49 grams. The mean platelet volume (fl) was 7.31±0.92 (fl). Mean platelet volume was 8.52±0.51 (fl) in septic neonates and 6.97±0.70 (fl) in neonates without sepsis (p<0.001).
Conclusion: Neonates having sepsis were found to have significantly raised mean platelet volume. As a result, mean platelet volume is available in complete blood counts without additional cost to prove cost-effective.

Keywords: Body temperature, Mean platelet volume, Sepsis.

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INTRODUCTION

Neonatal sepsis is a systemic infection occurring in infants less than 28 days of life and is among the leading causes of morbidity and mortality in neonates,[1,2] especially in preterm and low birth weight babies.[3]

Diagnosis of neonatal sepsis is a big challenge, owing to the subtle presentation and elusive range of signs and symptoms which may overlap with multiple noninfectious conditions. Blood culture is considered the gold standard, but its result takes time. Other indicators like C-Reactive Protein (CRP) and procalcitonin (PCT) are also available but are costly and time-consuming.[4]

A complete blood count (CBC) is usually done to screen for neonatal sepsis. In CBC, high or low total leucocyte count (TLC) and premature white cells are important markers suggesting sepsis. In the same test, mean platelet volume (MPV) has emerged as another promising marker without additional cost. MPV is defined as the average size of platelets in blood volume and is one of the most significant platelet indices having sensitivity and specificity ranging between 70-97% and 82-100%, respectively, in neonatal sepsis.[5] MPV directly relates to the rate of platelet production in the bone marrow and is inversely related to the degree of platelet maturation.[6,7] The severity and invasiveness of systemic infection are directly related to an increase in MPV. MPV tends to arise whenever there is platelet destruction, as observed in sepsis due to inflammatory cytokines.[8] An automated haematology analyzer performs MVP by either optical or electrical impedance method, which is available even at district-level hospitals in Pakistan.[9-10]

As local data in this regard is lacking, this study will help to compare MPV in patients with or without sepsis. Furthermore, an increase in mean platelet volume with neonatal sepsis can help us in early screening of the neonates, leading to timely administration of treatment which can help in prompt management of neonatal sepsis and decrease mortality and morbidity associated with it. Therefore, this study aimed to find out MPV in neonates with sepsis.

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METHODOLOGY

This cross-sectional study was carried out at the Neonatal Intensive Care Unit, Department of Paediatrics, Military Hospital, Rawalpindi Pakistan, from July 2017 to January 2018. The sample size was calculated to be 140 using a 95% confidence level and 8% margin of error while taking the expected frequency of neonatal sepsis to be 35%.[6] A total of 140 neonates were included in the study using non-probability, consecutive sampling technique.

Inclusion Criteria: Neonates (both preterm and term) of either gender with suspicion of neonatal sepsis presented with any two of the signs: a core body temperature of more than 38.5°C or less than 36°C at the time of presentation, pulse rate beyond the range of 100-200 beats/minute, leukocyte count beyond the range of 4000 to 30,000/mm3 or >10% immature neutrophils on peripheral smear, tachypnea (>60 breaths/minute) and oxygen saturation (<90%) on pulse oximeter were included in the study.

Exclusion Criteria: Patients having respiratory distress syndrome, meconium aspiration syndrome, congenital heart defects, metabolic diseases, dehydration or iatrogenic hypo/hyperthermia were not enrolled. In addition, patients who had taken more than two doses of antibiotics in the last 48 hours as per history and clinical record were excluded from the study.

After approval from the Ethical Review Committee of the hospital, 140 neonates who presented in the paediatric emergency department of Military hospital Rawalpindi Paksitan with suspicion of neonatal sepsis, who fulfilled the inclusion and exclusion criteria, were included. Their parents were counselled, and the study details were explained to them. Written informed consent and detailed history were taken from the parents of each patient.

A blood sample of 3 ml was drawn and sent for culture, and another 3 ml of blood for peripheral smear and CBC, including mean platelet volume for all enrolled cases. All the data was noted and recorded with the patients' demographic details. All the labs were acquired from the same laboratory (in Military Hospital, Rawalpindi), and the peripheral smear was done by the same consultant of the pathology department to eliminate bias.

Statistical Package for Social Sciences (SPSS) version 20.0 was used for the data analysis. The frequency of culture-proven sepsis was noted. Numerical variables, i.e., age and mean platelet volume, were presented by mean±SD. Categorical variables, i.e., gender and culture-proven neonatal sepsis, were presented as frequency and percentage. An independent sample t-test was applied, taking the *p*-value of <0.05 as statistically significant.

RESULTS

Out of 140 neonates enrolled in the study, 74 (52.86%) were male and 66 (47.14%) females. The age distribution of the neonates showed that 43 (30.71%) were between 0-7 days, whereas 97 (69.29%) were between 8-28 days. There were 57 (40.71%) cases that had <37 weeks of gestation and 83 (59.29%) with >37 weeks of gestation, while the mean gestational age was noted to be 37.04±1.76 weeks. The mean neonatal birth weight was 2344.28±437.49 grams. The fre-quency of culture-proven neonatal sepsis was noted in 31 (22.14%) cases (Table-I). MPV in neonates with sepsis was 8.52±0.51(fl) and was 6.97±0.70 (fl) in cases without sepsis (*p*-value < 0.001) (Table-II).

Table-I: Frequency of Neonatal Sepsis in Neonates (n=140)

Neonatal Sepsis (Culture Proven)	n (%)
Yes	31 (22.14)
No	109 (77.86)

Table-II: Comparison of Mean Platelet Volume (fl) in Patients with and without Sepsis (n=140)

Sepsis/without sepsis	Mean Platelet Volume, fl	*p*-value
Sepsis	8.52±0.51fl	<0.001
Without sepsis	6.97±0.70fl	

DISCUSSION

Sepsis in neonates is considered a systemic inflammatory response to an infectious process, which can manifest by multiple systemic signs and symptoms. The evaluation of a newborn for infection or sepsis includes a detailed history, evidence of other diseases that may increase the risk of infection or overlap with signs of sepsis, evidence of any systemic disease, and certain laboratory parameters. Among these parameters, blood culture is considered a "gold standard".[11] Some of the limitations of blood culture are that it is not completely free of error because false negative results can occur due to low yield; which can be because of inadequate volume of the sample, earlier administration of antibiotics or low-grade bacteremia. In addition, a larger amount of blood is needed to be drawn, technique, cost, and expertise, and it is also time-consuming. Hence, these can result in the underdiagnosis of truly infected new-borns. Both clinical and

lab parameters are considered together to diagnose neonatal sepsis.[12] Some studies consider the presence of only one clinical parameter along with a lab parameter like a C-reactive protein (CRP) value greater than 10mg/dl to be enough criteria in diagnosing not only early-onset neonatal sepsis but also late-onset neonatal sepsis.[13,14] Therefore, there is a need to find alternate rapid methods like haematological indices (abnormal total leucocyte count, band cells), acute phase reactants, C-reactive protein(CRP), cytokines (IL-6, IL-8), TNF- α, procalcitonin (PCT), cell surface markers, among other biomarkers. We need further research to look for a parameter with high diagnostic accuracy and high validity. Septicaemia often involves platelets and can cause severe thrombocytopenia and an increase in MPV.[15]

Van Der Leile *et al.*[16] were among the pioneers who studied an increase in MPV in septic neonates. He stated that there is increased thrombocytosis during sepsis, which results in an increased number of megakaryocytes and, therefore, an increase in MPV. An increased MPV in a patient with bacterial infection may point towards the invasive nature of the infection, which further indicates that septicaemia has set in.[5] A persistent rise of MPV or further increase in MPV may indicate the inadequacy of treatment given to the patient. Once *et al.* in Turkey found that MPV among septic and non-septic neonates was 8.82 + 0.8 vs 7.58 + 0.45 fl, respectively (*p*-value=0.001).[8] Our findings agreed with the above study, where MPV in neonates with sepsis was 8.52 + 0.51(fl). A statistically significant rise in MPV from baseline was reported by Guida *et al.* in patients with neonatal sepsis.[17] Guclu *et al.*[18] found that MPV levels of more than 8 fl have moderate (53.47%) sensitivity and good (87.41%) specificity for diagnosing sepsis. A case-control study conducted by Shalaby *et al.* in 2017 in Egypt concluded that neonates with sepsis showed statistically higher values of MPV, with a diagnostic cut-off value of 10. 2fl.[19] Raised MVP could indicate endothelial damage and platelet activation, while platelet consumption and MVP are thought to arise in acute infection phases.[20]

Golwala *et al.*[21] concluded that the ratio of MPV to plateletcrit (PCT), the ratio of platelet distribution width (PDW) to platelet count (PDW/platelet count) and the ratio of MPV to platelet count (MPV/ platelet count), in the first sample after admission, can predict 65% to 67% of deaths accurately. Zhang *et al.*[22] studied that patients with abnormally low platelet count and high MPV value had more severe illnesses and higher mortality than patients with normal platelet indices. Further studies of other platelet indices in neonatal sepsis can prove beneficial.

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LIMITATIONS OF STUDY

We considered cases suspected of neonatal sepsis as per defined criteria, further studies comparing neonatal sepsis cases with predefined controls will further elaborate on the significance of MVP in these cases.

CONCLUSION

Neonates having sepsis were found to have significantly raised mean platelet volume. In addition, mean platelet volume is available in compete blood counts without additional cost, so that it can prove cost-effective as well.

Conflict of Interest: None.

Author's Contribution

AA: Design the study, analysis and interpretated result, NU: Interpretated results, AB: Data interpretation, manuscript writing, US: Revision and approval of manuscript, SA: Coordinated and supervisied data collection, MFS: Approval of final manuscript.

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