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ORIGINAL RESEARCH

Role of Platelet Parameters - Mean platelet volume (MPV), and Platelet distribution width (PDW) as markers for diagnosing Neonatal Sepsis

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ABSTRACT

Background: Neonatal sepsis is a leading cause of neonatal hospitalization, contributing to 26% of global neonatal deaths. Early diagnosis and treatment can improve the outcome of neonatal sepsis. This study aimed to evaluate MPV and PDW as markers for neonatal sepsis and their correlation with CRP levels. **Materials and Methods:** This cross-sectional study was conducted in the neonatal intensive care unit (NICU) between 1st January 2021 and July 2022. The study included 80 neonates with clinical signs of sepsis, positive sepsis screening, or infection risk factors as the case group, and 80 age- and gender-matched healthy neonates as the control group. At the time of clinical diagnosis and prior to antibiotic initiation, complete blood count (CBC) including platelet parameters—mean platelet volume (MPV), platelet distribution width (PDW), CRP were done. **Results:** The mean birth weight of neonates with sepsis was 2.5±0.7 days and in healthy neonates was 2.8±0.5 days, with a male:female ratio of 1:1 in both groups. Neonatal sepsis was found to be associated with several risk factors, including meconium aspiration, PROM, parity, prematurity, and low birth weight. MPV was notably elevated in affected neonates, which also demonstrated significant correlation with CRP levels. **Conclusion:** MPV could serve as useful diagnostic tools for neonatal sepsis.

Keywords: Mean platelet volume, platelet count, platelet distribution width, sepsis

INTRODUCTION

Neonatal sepsis is a systemic inflammatory response to infection or bacterial presence in the blood within the first 28 days of life.[1] It is a leading cause of neonatal hospitalization, contributing to 26% of global neonatal deaths.[2] In India, the National Neonatal Perinatal Database (NNPD) reported an incidence of 8.5 per 1,000 live births in 2002–2003.[3] Neonates are highly vulnerable due to their immature immune systems, reduced white cell phagocytic activity, and underdeveloped skin barriers.[4-6] Risk factors include prematurity, low birth weight, prolonged rupture of membranes (PROM), maternal fever, obstructed labor, and birth asphyxia.[7] Though treatable if detected early, its nonspecific symptoms complicate timely diagnosis.[8] Consequently, antibiotics are frequently started on minimal suspicion, which helps manage infections but raises concerns about side effects and resistance.[9,10] Blood culture remains the diagnostic gold standard, despite a 36-hour turnaround.[11] After this period, sensitivity and specificity reach 100%.[12] An ideal diagnostic test should be rapid, affordable, and reliable. C-reactive protein (CRP), identified in 1930 by Tillet and Francis, helps bind complement to damaged cells, peaking after 50 hours.[9] Though nonspecific, CRP supports sepsis diagnosis when combined with clinical signs.[13] Hematologic markers like red blood cell distribution width (RDW), leukocyte count, mean platelet volume (MPV), and platelet distribution width (PDW), measured via complete blood count, offer additional clues. PDW reflects platelet size variation and indicates platelet shedding. RDW and PDW have been linked to conditions such as chronic urticaria and gram-negative bacteremia.[14] MPV has been routinely measured since the 1970s and inversely correlates with platelet count, though its clinical role in sepsis remains unclear. Neonates with RDS and bronchopulmonary dysplasia show elevated MPV, but

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its use in sepsis is underexplored.[15] This study aimed to evaluate MPV and PDW as markers for neonatal sepsis and their correlation with CRP levels.

MATERIALS AND METHODS

This cross-sectional study was conducted in the neonatal intensive care unit (NICU) of a tertiary care hospital between 1st January 2021 and July 2022 after obtaining approval from Institutional Ethical Committee. Study included 80 neonates with clinical signs of sepsis, with or without positive blood culture, but positive sepsis screening, and those with high risk factors for infection, which formed the case group, and 80 age- and gender-matched neonates with no clinical signs of sepsis, negative sepsis screen, and no history of high-risk factors for infection, which constituted the control group. Patients with any major congenital anomalies, prior antibiotic exposure, and those whose parents did not give consent were excluded from the study. Written informed consent was obtained from the parents or legal guardians of all the neonates prior to their enrolment in the study.

METHODOLOGY

A standardized protocol was developed for the evaluation of neonates, incorporating a detailed history, physical examination, and relevant investigations recorded in a predesigned proforma. Risk factors and clinical features suggestive of sepsis were documented. At birth, maternal history—including gestational age, prior obstetric history, underlying illnesses, and antenatal complications—was obtained. At the time of clinical diagnosis and prior to antibiotic initiation, the following investigations were conducted: complete blood count (CBC) including platelet parameters—mean platelet volume (MPV), platelet distribution width (PDW), CRP in both cases and controls. Blood culture was performed only in suspected sepsis cases. For CBC, samples were collected in EDTA tubes and analyzed using the CELLTAC ES analyzer, which processed samples automatically and generated results within 5 minutes. CRP was measured from serum obtained after centrifuging clotted blood in plain tubes; 50 µL of serum was mixed with one drop of CRP antigen and analyzed immediately. For blood culture, 2 mL of venous blood was aseptically collected and inoculated into culture bottles, which were incubated at 37°C for 5–7 days in the microbiology lab. Positive cultures were sub-cultured on blood agar, and microorganisms were identified using standard bacteriological methods. Neonates diagnosed with clinical sepsis were treated promptly following established hospital protocols.

STATISTICAL ANALYSIS

Statistical analysis was conducted with SPSS version 16. The Kolmogorov–Smirnov test was used to assess data distribution. For inferential analysis, the unpaired t-test was applied to compare means between two groups for normally distributed numerical data, while the chi-square test was used to compare proportions for categorical variables. Spearman's correlation coefficient was employed to evaluate the relationship between CRP and study parameters. A p-value of less than 0.05 was considered statistically significant.

RESULTS

In this study, both case and control groups enrolled 80 patients each. There was no difference in gender distribution between case and control groups, with a male:female ratio of 1:1. Mode of delivery was lower segment cesarean section (LSCS) in majority of study participants in both groups (57.50%). Majority of neonates were full term at the time of delivery in both case and control groups (78.8%). The mean birth weight of neonates in case group was 2.5±0.7 days and in control group was 2.8±0.5 days. This difference was statistically significant (p=0.016). (Table 1)

Table 1: Characteristics of Study Participants

Patient Characteristics		Group		
		Case (n=80)	Control (n=80)	Total (n=160)
Gender	Female	40	40	80
		50.0%	50.0%	50.0%
	Male	40	40	80
		50.0%	50.0%	50.0%
Mode of Delivery	LSCS	48	44	92
		60.00%	55.00%	57.50%
	Vaginal	32	36	68
		40.00%	45.00%	42.50%
Obstetric history	Primi	33	39	72
		41.2%	48.8%	45.0%
	Multi	47	41	88
		58.8%	51.2%	55.0%
Gestational Age	Term	53	73	126
		66.2%	91.2%	78.8%
	Preterm	27	7	34

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		33.8%	8.8%	21.2%
Mean birth weight (kg)		2.5±0.7	2.8±0.5	

Meconium aspiration (16.2%) and PROM (16.2%) were the two common predisposing factors for sepsis observed in this study, and respiratory distress (70%) followed by lethargy (16.5%) were the more frequently observed clinical features. (Table 2)

Table 2: Predisposing factors leading to Sepsis in Study Participants

Sepsis related factors		Present	Absent
Predisposing factors for Sepsis	Maternal fever	2 (2.5%)	78 (77.5%)
	Maternal UTI at the time of delivery	5 (6.2%)	75 (73.8%)
	Meconium Aspiration	13 (16.2%)	67 (83.8%)
	PROM	13 (16.2%)	67 (83.8%)
Clinical features	Refusal to feed	4 (5.0%)	76 (95.0%)
	Hypotension	2 (2.5%)	78 (97.5%)
	Respiratory Distress	56 (70.0%)	24 (30.0%)
	Lethargy	13 (16.5%)	67 (83.5%)

There was no significant difference in the mean MPV and PDW% between case and control groups in this study. (Table 3)

Table 3: Mean and Standard Deviation of Study Parameters in Cases and Controls

Group		N	Mean	Std. Deviation	P value	Significance
MPV	**Case**	80	7.53	0.85	0.506	Not Significant
	Control	80	7.36	2.17		
PDW %	**Case**	79	18.1	2.4	0.193	Not Significant
	Control	80	17.6	2.8		

MPV was more than 7 (>7) in 53 out of 80 cases and in 38 out of 80 controls. This difference was found to be statistically significant (p=0.017). PDW was more than 17 (>17) in 61 cases and 57 controls. There was no significant association between PDW and neonates with sepsis (p=0.472). (Table 4)

Table 4: Comparison of MPV and PDW between Cases and Controls

		Group		Total	p-value
		Case	**Control**		
MPV	**>7**	53	38	91	**0.017 S**
		66.2%	47.5%	56.9%	
	≤7	27	42	69	
		33.8%	52.5%	43.1%	
PDW	**>17**	61	57	118	0.472 NS
		76.2%	71.2%	73.8%	
	≤17	19	23	42	
		23.8%	28.8%	26.2%	

The sensitivity and specificity of MPV >7 was 66.3% and 52.5%, and PDW >17 was 76.3% and 28.8%, respectively. (Table 5)

Table 5: Validity of MPV as a marker in neonatal sepsis

Validity	MPV > 7		PDW >17	
	Value	**95% CI**	**Value**	**95% CI**
Sensitivity	66.3	54.8 – 76.5%	76.3	65.4 – 85.1%
Specificity	52.5	41.0 – 63.8%	28.8	19.2 – 39.5%
Positive Predictive Value	58.2	51.3 – 64.8%	51.7	47.1 – 56.3%
Negative Predictive Value	60.9	51.8 – 69.3%	54.8	41.8 – 67.1%
Accuracy	59.4	51.3 – 67.1%	52.5	44.5 – 60.4%
Positive Likelihood Ratio	1.39	1.06-1.84	1.07	0.89 – 1.29
Negative Likelihood Ratio	0.64	0.44-0.93	0.83	0.49 – 1.39

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There was a positive correlation between MPV and CRP among neonatal sepsis cases (N=80), with a Spearman's Correlation Coefficient of 0.2555, which was statistically significant ($p<0.05$). (Figure 1)

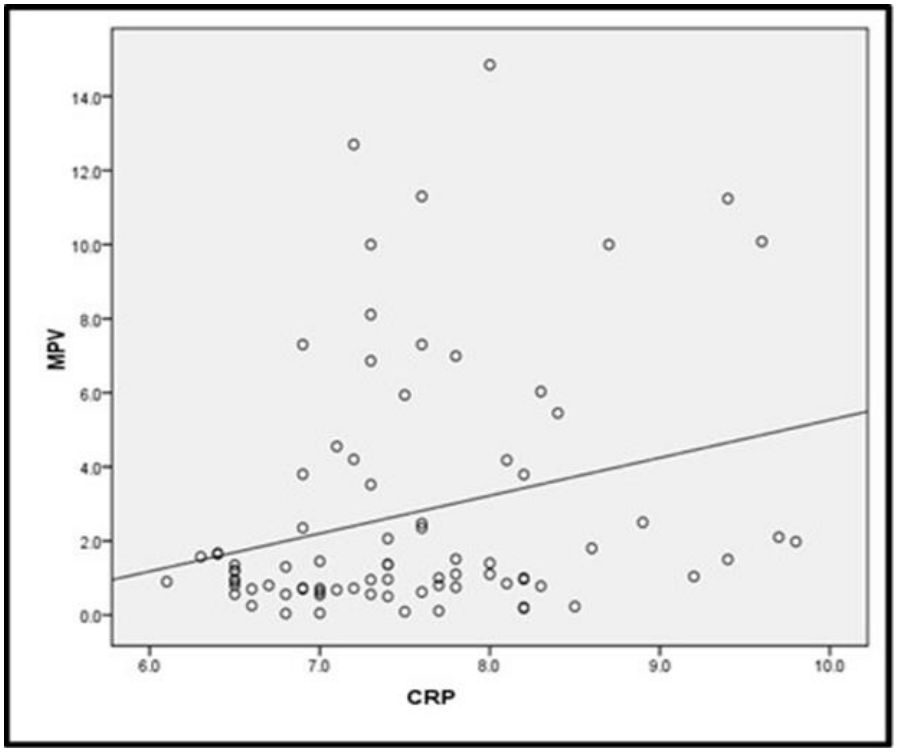

Figure 1: Correlation between MPV and CRP

There was a weakly positive correlation between PDW and CRP in case group, with a Spearman's Correlation Coefficient of 0.113, which was not statistically significant ($p=0.32$). (Figure 2)

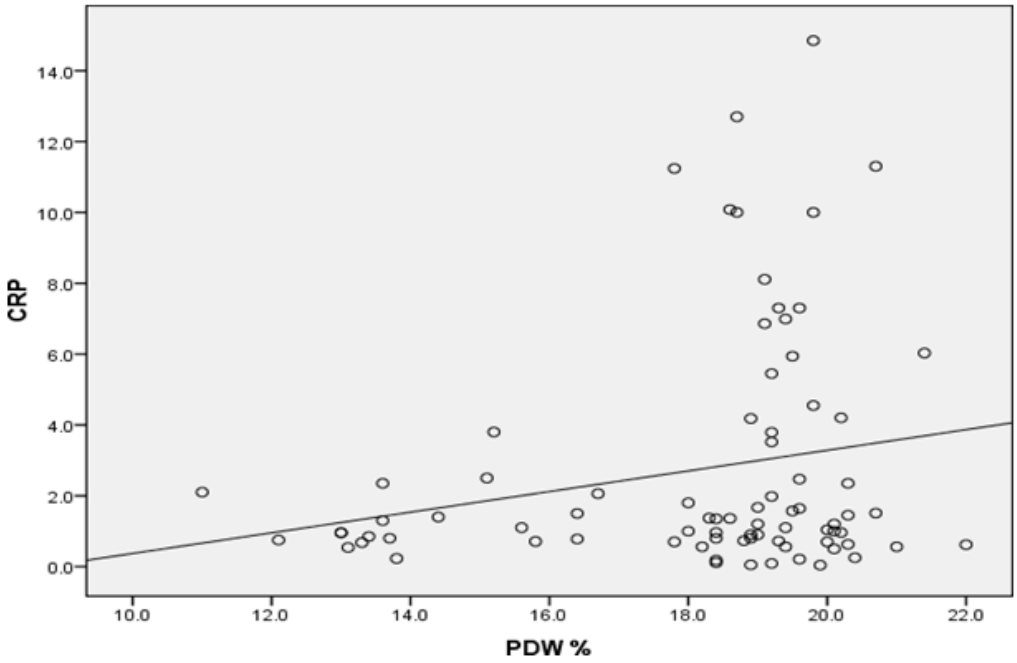

Figure 2: Correlation between PDW and CRP

DISCUSSION

Sepsis is one of the most common causes of neonatal hospitalizations, which accounts for 30 to 50% of neonatal deaths in developing countries.[2,11] Early diagnosis and treatment can improve the outcome of neonatal sepsis. The gold standard for diagnosis of sepsis is blood culture but the technique is time consuming with the assay time of up to 48-72 hours

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and yields a positive result in only 10-60% of cases.[3] Early diagnosis and treatment can improve the outcome of neonatal sepsis. Hence there is a need for an inexpensive rapid screening test that can identify neonates with sepsis at the time of initial assessment. There are very few studies done in India to evaluate the role of Platelet parameters in neonatal sepsis.[16] This study focused on assessing PDW and MPV as potential indicators of neonatal sepsis.

In our study, there was no significant difference in the gender distribution between neonates with sepsis and healthy newborns, (Table 1) which is in accordance with previous studies involving neonates by Essayad AS et al[17] and Gad G et al[18]. In contrast to these findings, several studies have observed male dominance among neonates with sepsis.[5,19] We observed that sepsis was more common in neonates delivered by LSCS (60%) as compared to the neonates born by normal vaginal delivery (40%). Similar observations were made in a previous study by Werner EF et al[20] which showed that caesarean delivery was associated with increased odds of neonatal sepsis, when compared to vaginal delivery. In a similar study by Prathyusha et al[21], babies born by normal vaginal delivery (NVD) were higher in the control group and those born by LSCS were higher in the study group ($p<0.001$). In our study, 41.2% neonates in the sepsis group were born to primigravida while 58.8% to multigravida, which was statistically significant. One study reviewed 225 neonates at a tertiary care NICU at Ethiopia and discovered that more than half of the mothers 124 (55.1%) were multigravida.[22]

Prematurity is an important factor in the occurrence of neonatal sepsis.[23] In our study, amongst 80 neonates with sepsis, 66.2% were born at term and 32.8% were born preterm whereas in control group, 91.2% neonates were born at term and 8.8% were born preterm and this difference was statistically significant ($p<0.001$). One similar study found that prematurity carried 4.85 times risk for development of sepsis ($p<0.0001$).[5] One systematic review by Murthy S et al[23] stated that early gestational age is a risk factor for neonatal sepsis. These findings are in accordance with previous literature.[19,24] We observed that the mean birth weight of neonates in case group was significantly lower than in control group ($p=0.016$). Similarly, Shah GS et al[5] found that low birth weight carried 4.85 times higher risk for development of sepsis ($p<0.0001$). Similar observations were made by Murthy S et al[23].

Our study assessed maternal and neonatal risk factors in septic neonates. Among these, 16.2% of cases had meconium aspiration, 16.2% had PROM, in 2.5% cases there was maternal fever, and in 6.2% cases there was maternal urinary tract infections. One similar study found PROM and pre-labour rupture of membranes as significant independent risk factors for neonatal infection.[25] These findings are in accordance with previous literature.[23,26] In our study, among the 80 neonates with sepsis, respiratory distress was observed in 70% cases, lethargy in 16.5% cases, refusal to feed in 5% and hypotension in 2.5% of cases. (Table 2) Lim WH et al[27] observed that most common presenting features of sepsis were poor activity (48.7%) and increased respiratory effort (43%). Another study observed that increasing apnea (55%), feeding intolerance, abdominal distension or guaiac-positive stools (43%), increased respiratory support (29%), lethargy and hypotonia (23%) were the dominant presenting features of septicemia in infants.[28] On the other hand, Stoll BJ et al[29], in a similar study, reported that respiratory and cardiovascular symptoms were most common in neonatal sepsis.

MPV is a simple marker reflecting platelet function. During the early stages of sepsis, platelet destruction leads to increased production and the release of larger, more active platelets. Elevated MPV reflects endothelial damage and platelet activation, which typically rise during acute infections.[21] In our study, MPV >7 had a sensitivity of 66.3% and specificity of 52.5%, with a PPV of 58.2% and NPV of 60.9%, indicating its moderate diagnostic value. A statistically significant positive correlation was found between MPV and CRP among sepsis cases ($p<0.05$). Other studies have consistently reported a significant association between MPV and neonatal sepsis. MPV showed high sensitivity (80–93%) and specificity (52–84%) across various studies [21,30-33], with some suggesting it rises earlier than CRP, supporting its role as an early diagnostic marker. Additionally, statistically significant differences in MPV were observed between septic and control groups in our study, reinforcing its potential as a supportive tool for early sepsis detection.

PDW reflects platelet size variability and morphological heterogeneity. Under physiological conditions, PDW and MPV tend to vary in the same direction and are associated with platelet activation. In our study, PDW >17 had a sensitivity of 76.3% and specificity of 28.8% for detecting neonatal sepsis. The positive predictive value (PPV) was 51.7%, and the negative predictive value (NPV) was 54.8%. A weak, non-significant positive correlation with CRP was observed ($p>0.05$). Other studies have similarly reported elevated PDW in neonatal sepsis. One study found PDW sensitivity of 79.5% and specificity of 36.6%, with significant differences in PDW values between septic and control groups.[30]. Another reported PDW >16.8 in 72.1% of septic neonates.[34] Research has also shown that PDW levels rise early during infection and may serve as useful diagnostic and prognostic biomarkers for neonatal sepsis.[35] This single-center study's small sample limits generalizability; broader studies are needed to validate findings and explore links between biomarkers, sepsis severity, and outcomes.

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CONCLUSION

Neonatal sepsis was found to be associated with several risk factors, including meconium aspiration, PROM, parity, prematurity, and low birth weight. MPV was notably elevated in affected neonates, which also demonstrated significant correlation with CRP levels. Given their affordability, accessibility, and routine availability, these markers hold promise as practical diagnostic tools for neonatal sepsis, particularly in settings with limited resources.

REFERENCES

1. Chiesa C, Panero A, Osborn JF, et al. Neonatal sepsis: a clinical and laboratory challenge. Clin Chem 2004; 50(2): 279–287.
2. Lawn JE, Cousens S, Zupan J, et al. 4 million neonatal deaths: When? Where? Why? Lancet 2005; 365(9462): 891–900.
3. National Neonatal Perinatal Database. [Internet]. NNPD report 2002-03 [cited 2010 Sep 22]. Available from: http:// www.newbornwhoccorg/pdf/nnpd_report_2002-03 PDF; 2005
4. Levy O. Innate immunity of the newborn: basic mechanisms and clinical correlates. Nat Rev Immunol 2007; 7(5): 379–390.
5. Shah GS, Budhathoki S, Das BK, et al. Risk factors in early neonatal sepsis. Kathmandu Univ Med J 2006; 4(2): 187–191.
6. Trotman H, Bell Y, Thame M, et al. Predictor of poor outcome in neonates with bacterial sepsis admitted to the University Hospital of the West Indies. West Indian Med J 2006; 55(2): 80–83.
7. Ben Hamida Nouaili E, Harouni M, Chaouachi S, et al. Early onset neonatal bacterial infections: a retrospective series of 144 cases. Tunis Med 2008; 86(2): 136–139.
8. Shirazi H, Riaz S, Tahir R. Role of the Hematological Profile in Early Diagnosis of Neonatal Sepsis. Ann Pak Inst Med Sci. 2010;6(3):152-56.
9. Edgar JDM, Gabriel V, Gallimore JR, McMillan SA. A prospective study of the sensitivity, specificity and diagnostic performance of soluble intercellular adhesion molecule 1, highly sensitive C-reactive protein, soluble Eselectin and serum amyloid A in the diagnosis of neonatal infection. BMC Pediatr. 2010;10:22-25.
10. Haque KN. Neonatal Sepsis in the Very Low Birth Weight Preterm Infants:Part 2: Review of Definition, Diagnosis and Management. J Med Sci. 2010;3(1):11-27.
11. Antia-Obong CE, Utsalo SJ, Udo JJ, et al. Neonatal Septicaemia in Calabar, Nigeria. Central Afr J Med 1992; 36: 161–165
12. Mishra UK, Jacobs SE, Doyle LW, Garland SM. Newer approaches to the diagnosis of early onset neonatal sepsis. Arch Dis Child Fetal Neonatal Ed. 2006;91:208–12.
13. Kawamura M, Nishida H. The usefulness of serial C-reactive protein measurement in managing neonatal infection. Acta paediatrica. 1995;84(1):10–3.
14. Zhang, Hui-Bing; Chen, Juan; Lan, Qiao-Fen; Ma, Xiong-Jian; Zhang, Shi-Yan. Diagnostic values of red cell distribution width, platelet distribution width and neutrophil-lymphocyte count ratio for sepsis. Experimental and Therapeutic Medicine. 2016; 12: 2215-2219.
15. Oncel MY, Ozdemir R, Yurttutan S, Canpolat FE, Erdeve O, Oguz SS, Uras N, Dilmen U. Mean platelet volume in neonatal sepsis. J Clin Lab Anal. 2012 Nov;26(6):493-6.
16. Phares CR, Lynfield R, Farley MM, et al. Epidemiology of invasive group B streptococcal disease in the United States, 1999-2005. JAMA 2008; 299:2056.
17. Essayed AS, Gaafar MM, Elamin MM, El Gebaly SM. Evaluation of Neonatal Sepsis Based on Measurement of Red Cell Distribution Width. The Egyptian Journal of Hospital Medicine. 2021 Oct 1;85(2):4338-43.
18. Gad G, Ismail R, El-Masry S et al. (2014): Serum apelin in early-onset neonatal sepsis: is it diagnostic? Journal of Neonatal-Perinatal Medicine, 7(3):207-212
19. Mehar V, Agarwal S, Singh R, Agarwal A, Agrawal N, Majethia Aditi. Relationship between gestational age and mode of delivery with neonatal septicemia. International Journal of Contemporary Pediatrics. 2016;891-895. 10.18203/2349-3291.ijcp20162361.
20. Werner EF, Savitz DA, Janevic TM, Ehsanipoor RM, Thung SF, Funai EF, Lipkind HS. Mode of delivery and neonatal outcomes in preterm, small-for-gestational-age newborns. Obstet Gynecol. 2012;120(3):560-4. doi: 10.1097/AOG.0b013e318265b16c.
21. Prathyusha, Shreekrishna GN, Bhat S, Sahana P. Mean platelet volume (MPV) as a diagnostic marker in neonatal sepsis. Int J Contemp Pediatr 2019;6:1036-40
22. Tewabe T, Mohammed S, Tilahun Y, Melaku B, Fenta M, Dagnaw T, et al. Clinical outcome and risk factors of neonatal sepsis among neonates in Felege Hiwot referral Hospital, Bahir Dar, Amhara Regional State, North West Ethiopia 2016: a retrospective chart review. BMC Res Notes. 2017;10(1):265. doi: 10.1186/s13104-017-2573-1.
23. Murthy S, Godinho MA, Guddattu V, Lewis LES, Nair NS. Risk factors of neonatal sepsis in India: A systematic review and meta-analysis. PLoS One. 2019 Apr 25;14(4):e0215683. doi: 10.1371/journal.pone.0215683.
24. Bangi VAB, Syamala DS. Neonatal sepsis: A risk approach. Journal of Dr. NTR University of Health Sciences 3(4):p 254-258, Oct–Dec 2014. | DOI: 10.4103/2277-8632.146632
25. Oddie S, Embleton ND. Risk factors for early onset neonatal group B streptococcal sepsis: case-control study. BMJ. 2002 Aug 10;325(7359):308. doi: 10.1136/bmj.325.7359.308. PMID: 12169506; PMCID: PMC117770.
26. K Jaya Lakshmi, Geethashree H C. A study of maternal risk factors associated with early onset neonatal sepsis at a tertiary health care centre. MedPulse International Journal of Gynaecology. 2020; 13(2): 31-37.
27. Lim WH, Lien R, Huang YC, Chiang MC, Fu RH, Chu SM, et al. Prevalence and pathogen distribution of neonatal sepsis among very-low-birth-weight infants. Pediatr. Neonatol. 2012;53:228–234. 10.1016/j.pedneo.2012.06.003
28. Fanaroff AA, Korones SB, Wright LL, Verter J, Poland RL, Bauer CR, et al. Incidence, presenting features, risk factors and significance of late onset septicemia in very low birth weight infants. The National Institute of Child Health and Human Development Neonatal Research Network. Pediatr Infect Dis J. 1998;17(7):593-8. doi: 10.1097/00006454-

DOI: 10.69605/ijlbpr_14.5.2025.70

199807000-00004.
29. Stoll BJ, Hansen NI, Sánchez PJ, Faix RG, Poindexter BB, Van Meurs KP, et al. Early onset neonatal sepsis: the burden of group B Streptococcal and E. coli disease continues. Pediatrics. 2011 May;127(5):817-26. doi: 10.1542/peds.2010-2217.
30. Majumdar A, Biswas S, Jana A. Platelet indices as an earlier and economical marker of neonatal sepsis. Iraqi J Hematol 2021;10:108-11.
31. Sagheb S, Eshaghi H, Lamsehchi A. Role of Mean Platelet Volume in the Diagnosis of Neonatal Sepsis. Journal of Iranian Medical Council. 2022 Mar 1;5(1):111-7.
32. Pamudji K, Kardana IM. Diagnostic value of mean platelet volume in neonatal sepsis. PI [Inter Agrawal et al net]. 8Nov.2019 [cited 7 Jul.2022];59(6):289-3.
33. Pandian R, Kugonally G. Is mean platelet volume the earliest diagnostic marker of neonatal sepsis: a prospective case control study. IJCP. 2020; 7(6):12-19.
34. Akarsu S, Taskin E, Kilic M, Ozdiller S, Gurgoze MK, Yilmaz E, Aygun AD. The effects of different infectious organisms on platelet counts and platelet indices in neonates with sepsis: is there an organism-specific response? J Trop Pediatr. 2005;51:388-391.
35. Choudhary DK, Tiwari AK, Narang S, Chhabra J. Correlation of platelet count and platelet indices with neonatal sepsis-Diagnostic and prognostic indicator. Changes. 2017;17:16.