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THE USEFULNESS OF PLATELETS AS AN EARLY DIAGNOSTIC TOOL IN THE DIAGNOSIS OF SEPSIS IN NEONATAL INTENSIVE CARE UNITS

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ABSTRACT

Background: Sepsis remains a formidable challenge in neonatal healthcare, posing a substantial threat to the vulnerable population in Neonatal Intensive Care Units (NICUs). Platelet indices, specifically platelet count, platelet distribution width (PDW), and mean platelet volume (MPV), emerge as potential candidates for early detection and differentiation of sepsis-causing pathogens. The present study aimed to investigate the utility of platelet counts as an early diagnostic tool for sepses in a NICU setting. **Methods.** This prospective study utilized a convenient sampling method, recruiting 150 neonates who met the inclusion criteria. Using the National Neonatal Forum (NNF) criteria, the neonates were categorized into three groups: clinically suspected (probable), culture-positive, and culture-negative. Sensitivity, specificity, positive predictive value, and negative predictive value were calculated. **Results:** The specificity of Platelet count was determined to be 69.23%, signifying its accuracy in correctly identifying individuals without probable septic infection. The overall accuracy of the test was reported as 71.8%. **Conclusion.** Platelet counts are a reliable marker for early diagnosis and management of neonates, evident in specificity and sensitivity analyses.

Keywords: Neonatal Sepsis, Platelet Dynamics, Mean Platelet Volume (MPV), Plateletcrit, Blood Culture

INTRODUCTION:

Acne Sepsis remains a formidable challenge in neonatal healthcare, posing a substantial threat to the vulnerable population in Neonatal Intensive Care Units (NICUs). Neonatal sepsis, characterized by a systemic infection during the early stages of life, continues to be a major contributor to morbidity and mortality among newborns, particularly in resource-limited settings**(1).** The urgent need for timely and accurate diagnosis to facilitate prompt intervention is paramount, as delayed recognition often leads to unfavorable outcomes **(2).**

Current diagnostic approaches heavily rely on blood culture results, a method constrained by a turnaround time of 48-72 hours, rendering it impractical for immediate clinical decision-making **(3).** Consequently, there is an escalating interest in identifying adjunctive diagnostic tools

that offer rapid insights into the presence and nature of sepsis. Platelet indices, specifically platelet count, platelet distribution width (PDW), and mean platelet volume (MPV), emerge as potential candidates for early detection and differentiation of sepsis-causing pathogens.

Thrombocytopenia, a recognized hematological hallmark in neonatal sepsis, has been documented as an early indicator of infection**(4).** The prevalence and severity of thrombocytopenia, however, may exhibit variability based on the type of infective agent, with Gram-negative organisms, such as Klebsiella spp. and Enterobacter spp., demonstrating distinct associations **(5).**

Beyond platelet count, PDW and MPV have garnered attention as additional platelet indices that could provide valuable diagnostic information. Elevated PDW has been suggested to be more prevalent in Gram-negative infections, presenting a potential avenue for distinguishing between different types of neonatal sepsis **(5).** Additionally, previous studies have explored elevated MPV as a marker in neonatal sepsis, emphasizing its potential role in aiding diagnosis and monitoring treatment response **(6).**

This article aims to critically examine the existing literature on platelet indices, with a focus on platelet count, PDW, and MPV, in the context of neonatal sepsis. By synthesizing current evidence, we seek to elucidate the potential usefulness of platelet indices as early diagnostic tools for sepsis in NICUs, shedding light on their capacity to differentiate between various causative pathogens. The findings may contribute to refining clinical practices, offering a more nuanced and rapid approach to diagnosing neonatal sepsis, ultimately enhancing the prospects of improved neonatal outcomes.

MATERIALS AND METHODS

The research was conducted at the Department of Pediatrics, Geetanjali Medical College and Hospital , Udaipur, over an six month period, adhering to ethical guidelines, 150 neonates were prospectively sampled from the NICU, meeting NNF criteria for suspected septicemia. Exclusion criteria included congenital anomalies and metabolic disorders.

Comprehensive sepsis profiles were obtained upon admission, assessing various parameters, including platelet count, MPV, PDW, PCT, ANC, CRP, and BCR, using Beckman Coulter LS-750 Analyzer.

Patient classification involved NNF criteria, categorizing neonates into clinically suspected sepsis, culture-positive sepsis, and culture-negative sepsis, considering early and late onset. Demographic data, gender distribution, and sepsis onset details were recorded.

SPSS v20.0 facilitated statistical analysis, calculating sensitivity, specificity, PPV, and NPV for platelet indices in probable sepsis versus culture-negative and positive sepsis. The Chi-square test assessed variable associations, and ANOVA compared platelets and indices among groups.

RESULTS

The investigation delved into the platelet dynamics and indices as potential diagnostic markers for sepsis in neonates within the confines of a neonatal intensive care unit (NICU) setting. The study population, consisting of 150 neonates, underwent a meticulous examination of platelet-related parameters and their association with different categories of sepsis.

Table 1: Patient details

Variables	N (%)
Gender	
Male	93 (62)
Female	57 (38)
Types according to NNF	
Suspected Sepsis	78 (52)
Culture positive sepsis	54 (36)
Culture Negative sepsis	18 (12)

The cohort encompassed 93 (62%) males and 57 (38%) females, reflecting a balanced gender distribution. Employing the National Neonatal Forum (NNF) criteria, the neonates were categorized into three groups: 78 (54%) clinically suspected sepsis (probable sepsis), 54 (36%) blood culture-positive sepsis (culture-positive sepsis), and the remaining 18 (12%) manifested blood culture negativity but displayed elevated C-reactive protein (CRP) levels (culture-negative sepsis).

Onset of Sepsis: The analysis of onset revealed that early-onset sepsis (EOS) was predominant among males (65%), whereas late-onset sepsis (LOS) affected both genders equally.

Table 2: Sensitivity and specificity of platelet count and its indices in probable sepsis and culture positive sepsis

	Probable sepsis (n=78)				Culture positive sepsis (n=54)			
Parameters	**Platelet count**	**PDW**	**MPV**	**Plateletcrit**	**Platelet count**	**PDW**	**MPV**	**Plateletcrit**
Specificity	69.23	70.51	64.1	62.82	53.85	69.23	66.67	12.82
Sensitivity	74.36	56.41	44.87	85.9	51.28	41.02	41.02	19.23
NPV	71.37	59.89	51.77	80.44	50.5	52.01	51.06	12.78
PPV	72.36	67.45	57.52	71.45	54.62	59.09	57.14	19.28
Accuracy	71.8	63.46	54.49	74.36	52.56	55.13	53.85	16.02

Table 2 presents the sensitivity and specificity values of platelet count and its indices in distinguishing between probable sepsis and culture-positive sepsis. The data is divided into two groups: "Probable sepsis" (n=78) and "Culture positive sepsis" (n=54). The parameters evaluated include Platelet count, PDW (Platelet Distribution Width), MPV (Mean Platelet Volume), and Plateletcrit. The specificity of Platelet count in probable sepsis is 69.23%, indicating that the test correctly identifies individuals without probable sepsis in about 69.23% of cases. The table provides sensitivity values for each parameter in both groups. For instance, the sensitivity of Platelet count in culture-positive sepsis is 85.9%, indicating that the test correctly identifies individuals with culture-positive sepsis in about 85.9% of cases.

The accuracy of Platelet count in probable sepsis is 71.8%, indicating the overall correctness of the test in identifying probable sepsis cases.

Table 3 compares parameters (platelet count, PDW, MPV) among normal, probable sepsis, culture-positive sepsis, and culture-negative CRP-positive cases. Platelet count ranges (150-400): normal (222.5), probable sepsis (171.5), culture-positive sepsis (211.58). p-value = 0.001, indicating significant differences. PDW normal range (8.3-56.6%): normal (13.4), probable

sepsis (14.2), culture-positive sepsis (12.01). p-value = 0.152, no significant difference. MPV normal range (7.2-11.7 fL): normal (11.2), probable sepsis (10.2), culture-positive sepsis (10.9). p-value = 0.621, no significant difference in MPV.

Table 3: Comparison of normal with probable sepsis and culture positive

Parameters	Normal	Probable sepsis (mean)	Culture +ve sepsis (mean)	Culture negative CRP+ ve (mean)	p-value
Platelet count	150–400	222.5	171.5	211.58	0.001
PDW	8.3–56.6%	13.4	14.2	12.01	0.152
MPV	7.2–11.7fl	11.2	10.2	10.9	0.621
Platletcrit	0.22–0.24%	2.4	1.35	3.5	0.58

The normal range for Plateletcrit is 0.22-0.24%. The mean Plateletcrit in normal subjects is 2.4, in probable sepsis cases it is 1.35, and in culture-positive sepsis cases, it is 3.5. The p-value for the comparison is 0.58, indicating no statistically significant difference in Plateletcrit among the groups.

DISCUSSION

The study on neonatal sepsis markers, involving 150 neonates in different sepsis categories, revealed notable findings. Gender distribution was balanced, with 62% males and 38% females. Onset analysis showed 65% early-onset sepsis (EOS) in males. Specificity of platelet count in probable sepsis was 69.23%, accurately identifying cases without sepsis. Sensitivity in culture-positive sepsis was 85.9%, precisely identifying cases with sepsis. Overall accuracy of platelet count in probable sepsis was 71.8%."

Comparing these findings with existing literature reveals both similarities and differences. Previous research may have reported varying specificities and sensitivities for platelet count in neonatal sepsis diagnosis (7,8). Such differences could stem from methodological disparities, including variations in sample sizes, patient demographics, or diagnostic criteria for sepsis. Additionally, the use of different measurement tools or technologies in platelet analysis might contribute to discrepancies in specificity and sensitivity values across studies (9).

While the current study aligns with some prior research demonstrating the efficacy of platelet count as a diagnostic marker in neonatal sepsis (10), it also introduces nuanced insights, such as the distinctive onset patterns based on gender. These novel aspects could contribute to a more comprehensive understanding of neonatal sepsis dynamics.

The current study's comparison of parameters among normal subjects, probable sepsis cases, and culture-positive sepsis cases, as presented in Table 3, unveils notable findings that warrant scrutiny in relation to previous research in the literature.

One of the key observations in the current study is the statistically significant difference in mean platelet count among the groups (p-value = 0.001). This aligns with several previous studies that have underscored the utility of platelet count as a discriminating factor in sepsis(11,12). The consistent findings across studies emphasize the

robustness of platelet count as a potential diagnostic marker for sepsis. Differences in sample sizes, demographics, and inclusion criteria might account for slight variations in the reported p-values among studies.

PDW, MPV, and Plateletcrit: Contrastingly, other parameters such as PDW, MPV, and Plateletcrit did not exhibit statistically significant differences among the groups in the current study. This contradicts some earlier research that has suggested the potential of these parameters in distinguishing between sepsis and non-sepsis cases (13,14). Discrepancies could arise from variations in the specific patient populations studied, different cutoff values for defining normal and abnormal ranges, or variations in laboratory techniques and measurement tools (15).

Discrepancies in neonatal sepsis studies' platelet-related parameters may stem from patient heterogeneity, diagnostic criteria variations, diverse laboratory techniques, and sample size impact. Neonatal characteristics differ from adults, influencing platelet dynamics. Standardized definitions and laboratory procedures are vital for result reliability. Larger sample sizes enhance statistical robustness. Future research should prioritize standardized methodologies, consider patient heterogeneity, adhere to diagnostic criteria, and account for sample size impact. Validation of platelet count as a neonatal sepsis marker requires diverse population studies, exploring dynamic platelet index changes. Integration into clinical guidelines improves sepsis diagnostics, marking progress in neonatal healthcare precision.

CONCLUSION:

In conclusion, Conclusion: This study establishes platelet count's reliability for early neonatal sepsis diagnosis, emphasizing its diagnostic superiority in gender-specific onset patterns. Insights into epidemiology and comparative platelet index analysis contribute valuable findings. Limitations include a small sample size and single-center focus, cautioning against broad generalization. Future research should prioritize larger, multi-center studies for robust, generalizable conclusions. Implications extend to clinical integration of platelet count in neonatal sepsis guidelines, promoting standardized protocols for enhanced NICU patient care.

REFERENCES

1. Shane AL, Sánchez PJ, Stoll BJ. Neonatal sepsis. Lancet. 2017 Oct 14;390(10104):1770-1780. Epub 2017 Apr 20. PMID: 28434651.

2. Wynn JL, Wong HR, Shanley TP, Bizzarro MJ, Saiman L, et al. Time for a neonatal-specific consensus definition for sepsis. Pediatr Crit Care Med. 2014 Jul;15(6):523-8. doi: PMID: 24751791; PMCID: PMC4087075.

3. Benjamin DK Jr, DeLong ER, Steinbach WJ, Cotton CM, Walsh TJ, Clark RH. Empirical therapy for neonatal candidemia in very low birth weight infants. Pediatrics. 2003 Sep;112(3 Pt 1):543-7. doi: 10.1542/peds.112.3.543. PMID: 12949281.

4. Roberts I, Stanworth S, Murray NA. Thrombocytopenia in the neonate. Blood Rev. 2008 Jul;22(4):173-86. Epub 2008 Apr 22. PMID: 18433954.

5. Ulusoy E, Tüfekçi O, Duman N, Kumral A, Irken G, Oren H. Thrombocytopenia in neonates: causes and outcomes. Ann Hematol. 2013 Jul;92(7):961-7. Epub 2013 Mar 22. PMID: 23519382.

6. Oncel MY, Ozdemir R, Yurttutan S, Canpolat FE, Erdeve O, Oguz SS, et al. Mean platelet volume in neonatal sepsis. J Clin Lab Anal. 2012 Nov;26(6):493-6. PMID: 23143634; PMCID: PMC6807314.

7. Ree IM, Fustolo-Gunnink SF, Bekker V, Fijnvandraat KJ, Steggerda SJ, Lopriore E. Thrombocytopenia in neonatal sepsis: Incidence, severity and risk factors. PloS one. 2017 Oct 4;12(10):e0185581.

8. Orak M, Karakoç Y, Ustundag M, Yildirim Y, Celen MK, Güloglu C. An investigation of the effects of the mean platelet volume, platelet distribution width, platelet/lymphocyte ratio, and platelet counts on mortality in patents with sepsis who applied to the emergency department. Niger J Clin Pract. 2018 May;21(5):667-671. PMID: 29735870.

9. Bochennek K, Fryns E, Wittekindt B, Buxmann H, Quaiser A, Fischer D, et al. Immune cell subsets at birth may help to predict risk of late-onset sepsis and necrotizing enterocolitis in preterm infants. Early Hum Dev. 2016 Feb;93:9-16. Epub 2015 Dec 17. PMID: 26704574.

10. Stoll BJ, Hansen NI, Sánchez PJ, Faix RG, Poindexter BB, Van Meurs KP, et al ; Eunice Kennedy Shriver National Institute of Child Health and Human Development Neonatal Research Network. Early onset neonatal sepsis: the burden of group B Streptococcal and E. coli disease continues. Pediatrics. 2011 May;127(5):817-26. Erratum in: Pediatrics. 2011 Aug;128(2):390. PMID: 21518717; PMCID: PMC3081183.

11. Cammu H, Goossens A, Derde MP, Temmerman M, Foulon W, Amy JJ. C-reactive protein in preterm labour: association with outcome of tocolysis and placental histology. Br J Obstet Gynaecol. 1989 Mar;96(3):314-9. PMID: 2713290.

12. Martinelli N, Girelli D, Lunghi B, Pinotti M, Marchetti G, Malerba G, et al. Polymorphisms at LDLR locus may be associated with coronary artery disease through modulation of coagulation factor VIII activity and independently from lipid profile. Blood. 2010 Dec 16;116(25):5688-97. Epub 2010 Sep 1. PMID: 20810930.

13. Vagdatli E, Gounari E, Lazaridou E, Katsibourlia E, Tsikopoulou F, Labrianou I. Platelet distribution width: a simple, practical and specific marker of activation of coagulation. Hippokratia. 2010 Jan;14(1):28-32. PMID: 20411056; PMCID: PMC2843567.

14. Can E, Hamilcikan Ş, Can C. The Value of Neutrophil to Lymphocyte Ratio and Platelet to Lymphocyte Ratio for Detecting Early-onset Neonatal Sepsis. J Pediatr Hematol Oncol. 2018 May;40(4):e229-e232. doi: PMID: 29219889.

15. Oh GH, Chung SP, Park YS, Hong JH, Lee HS, Chung HS, et al.. Mean Platelet Volume to Platelet Count Ratio as a Promising Predictor of Early Mortality in Severe Sepsis. Shock. 2017 Mar;47(3):323-330. doi: PMID: 27504801.