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# DIAGNOSTIC VALUE OF PLATELET INDEX AS AN EARLY MARKER IN SUSPECTED NEONATAL SEPSIS IN THE NEONATOLOGY UNIT

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**ABSTRACT**
Sepsis neonatorum is a serious blood infection in newborns, mainly affecting premature or low birth weight infants. Early detection is tough, but new research suggests platelet indices could help diagnose it faster. The objective of this study is to analyze the diagnostic value of platelet indices (platelet count, MPV, and PDW) as early markers in suspected neonatal sepsis compared with the gold standard (blood culture). This was an observational analytical study with a retrospective cohort design conducted at the Adam Malik Hospital. A total of 115 suspected neonatal sepsis samples were enrolled. Data collection included demographic characteristics, platelet count, mean platelet volume (MPV), and platelet distribution width (PDW). The data were obtained from secondary sources in medical records and entered into the SPSS software for analysis. Statistical analysis was performed using receiver operator curve (ROC) to assess the diagnostic value of platelet indices (platelet, MPV, and PDW). The study involved 115 newborns suspected of neonatal sepsis, with 46.1% male and 53.9% female. Most were delivered via cesarean section and diagnosed with early onset sepsis. Common clinical signs included respiratory distress and distension. Key risk factors included prolonged rupture of membranes and low birth weight. Blood culture revealed Klebsiella pneumonia as the most common pathogen. Platelet indices showed varied sensitivity and specificity as predictors of sepsis. Diagnostic tests had low sensitivity but varied specificity for detecting sepsis with platelet count, MPV, and PDW.

Keyword: neonatal; platelet index; sepsis

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## INTRODUCTION

Sepsis neonatorum is a clinical condition caused by bacterial infection within the first month of a newborn's life. It is classified into early onset, occurring within the first 72 hours, typically transferred from mother to baby, and late onset, occurring after 72 hours, usually acquired from environmental pathogens or invasive procedures (Gomella et al., 2019; Shane et al., 2017). This condition is a major global issue leading to high morbidity and mortality in neonates, especially those who are premature or of low birth weight (Kardana, 2011). According to the World Health Organization (WHO), sepsis neonatorum causes approximately 1 million neonatal deaths each year, with 42% occurring within the first week (Kardana, 2011). Incidence rates vary, from 1-4 per 1000 live births in developed countries to 10-50 per 1000 in developing nations. In Indonesia, the incidence is around 9-30%, with mortality rates between 12-50% (Putri et al., 2025; Sianturi et al., 2016). Early symptoms can include respiratory distress, vomiting, and lethargy (Bakhuizen et al., 2014; Gautam et al., 2023; Nugraha et al., 2019). Diagnosis often relies on blood cultures, which can be complicated and time-consuming. Research suggests that platelet indices may serve as reliable markers for sepsis, potentially enabling quicker diagnosis and treatment in various healthcare settings; therefore, this study aims to address the existing gap in the literature by

exploring their potential use as tools to improve the early detection of neonatal sepsis (Gautam et al., 2023; Nguyen et al., 2023; Wynn & Wong, 2017).

## METHOD

This is an analytical observational study with retrospective cohort approach to assess the diagnostic value of platelet index as an early marker in suspected neonatal sepsis in in the neonatology unit in Adam Malik Hospital. The sample size of this study is at least 32 samples. The inclusion criteria are neonates suspected of neonatal sepsis who are treated in the Neonatology Unit at Adam Malik Hospital, neonates are at risk of early-onset sepsis if they meet two major criteria or one major criterion plus two minor criteria, major risk factors (premature rupture of membranes (PROM) for more than 18 hours, intrapartum fever in the mother with a temperature above 38°C, chorioamnionitis, foul-smelling amniotic fluid, or fetal heart rate exceeding 160 beats per minute), minor risk factors (PPROM exceeding 12 hours, intrapartum fever with a temperature above 37.5°C, low APGAR score (score < 5 at 1 minute and score < 7 at 5 minutes), very low birth weight (< 1500 grams), gestational age < 37 weeks, untreated vaginal discharge, or mother suspected of having a urinary tract infection), newborns are at risk for late-onset neonatal sepsis if they exhibit early signs and symptoms of sepsis, including at least one of the following clinical manifestations (general, respiratory system, renal system; central nervous system; hematological system). This study has exclusion criterion are neonates who have not undergone the necessary complete laboratory tests, neonates who died before blood culture was performed, neonates with hereditary hematological disorders that affect platelet count or function, neonates with major congenital heart disease, neonates with congenital infections, and neonates with incomplete medical records.

Data collection was initiated after receiving ethical approval from the Research Ethics Committee of Universitas Sumatera Utara and authorization from the Education and Medical Research Division of Adam Malik Hospital. The study reviewed neonatal medical records that fulfilled the inclusion and exclusion criteria—covering both early- and late-onset sepsis cases—treated in the Neonatology Unit between May 2023 and May 2024. The gathered information included patient characteristics such as chronological and gestational age, birth weight, APGAR score, clinical diagnosis, along with maternal and neonatal risk factors. Laboratory findings including platelet count, MPV, PDW, IT ratio, CRP, and blood culture results were also obtained. All data were subsequently organized and processed using SPSS software for further analysis. Univariate and bivariate analysis is conducted using t-independent test if the data is normally distributed and if it is not normally distributed, it will be tested with Mann-Whitney test; the degree of confidence used is 95%. Diagnostic analysis test is conducted with platelet indices (thrombocyte, MPV, and PDW) using Receiver Operator Curve (ROC) to assess the suggested area under the curve (AUC), sensitivity, specificity, positive predictive value (PPV), and negative predictive value (NPV). This study has obtained permission from the Research Ethical Committee of Faculty of Medicine Universitas Sumatera Utara Medan.

## RESULT

This study analyzed 115 neonatal cases that met the selection criteria. The majority were female and delivered via cesarean section. Early-onset sepsis occurred more frequently, commonly presenting with respiratory distress. Prolonged rupture of membranes was the main maternal risk factor, while low birth weight and asphyxia were the most frequent neonatal factors. Statistical analysis showed no significant difference between groups, and platelet indices were assessed for their diagnostic performance in detecting neonatal sepsis.

The mean platelet index values for culture results are presented in Table 2. The median platelet count in culture tests with positive results increased compared to the median platelet count in culture tests with negative results. However, there was no significant difference in the mean MPV and PDW values between positive and negative culture tests.

Table 1.
Demographic Distribution Data Characteristics

| Characterisrics | Positive Culture n=48 (f(%)) | Negative Culture n=67 (f(%)) | n=115 (f(%)) | p-value |
|---|---|---|---|---|
| Sex (%) | | | | 0,421 |
| Male | 20 | 33 | 53 (46,08%) | |
| Female | 28 | 34 | 62 (53,91%) | |
| Mode of delivery (%) | | | | 0,356 |
| Sectio caesaria | 36 | 55 | 91(79,13%) | |
| Spontaneous vaginal | 12 | 12 | 24 (20,86%) | |
| Onset | | | | 0,035 |
| Early (< 72 jam) | 22 | 53 | 75 (65,21%) | |
| Late (> 72 jam) | 26 | 14 | 40 (34,78%) | |
| Clinical Manifestation | | | | 0.879 |
| Dyspneu | 34 | 51 | 85 (73,91%) | |
| Fever | 2 | 1 | 3 (2,60%) | |
| Abdominal distention | 7 | 8 | 15 (13,04%) | |
| Vomitting | 2 | 2 | 4 (3,47%) | |
| Convulsion | 3 | 5 | 8 (6,95%) | |
| Maternal Risk Factors | | | | 0,435 |
| PROM > 18 jam | 30 | 33 | 63 (54,78%) | |
| PROM > 12 jam | 10 | 23 | 33 (28,69%) | |
| Fever | 7 | 10 | 17 (14,78%) | |
| UTI | 1 | 1 | 2 (1,73%) | |
| Neonates Risk Factors | | | | 0,738 |
| Birth Weight | | | | |
| Low Birth Weight (< 2500 g) | 19 | 21 | 40 (34,78%) | |
| Very Low Birth Weight (< 1500 g) | 10 | 17 | 27 (23,47%) | 0,202 |
| Extremely Low Birth Weight (< 1000 g) | 1 | 3 | 4 (3,47%) | |
| Gestational Age | | | | |
| Extremely preterm (< 28 weeks) | 1 | 5 | 6 (5,21%) | 0,717 |
| Very preterm (28 - <32 weeks) | 14 | 16 | 20 (17,39%) | |
| Moderate - late preterm (32 - <37 weeks) | 11 | 24 | 35 (30,43%) | 0,651 |
| Aterm (37 - 42 weeks) | 22 | 22 | 44 (38,26%) | |
| Asphyxia | 22 | 33 | 55 (47,82%) | |
| Meconium Aspiration | 14 | 17 | 31 (26,95%) | |

Table 2.
Mean and SD Platelet Indices based on Culture Results

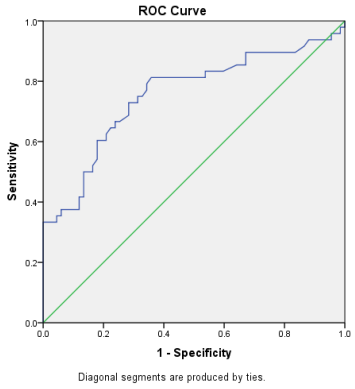
| Platelet Indices | Positive Culture (Mean ± SD) | Negative Culture (Mean ± SD) |
|---|---|---|
| Platelet Count | 310.500 (39.000-653.000) | 168.000 (24.000-415.000) |
| MPV | 10,46 ± 1,128 | 10,31± 1,225 |
| PDW | 10,55 (7,40-23,20) | 9,9 (8,20-19,70) |

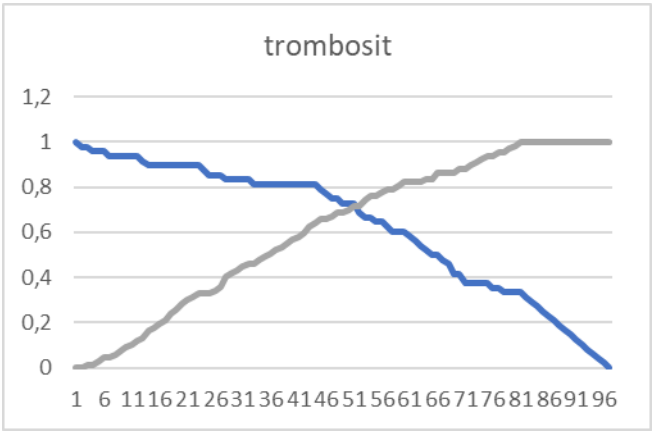
Table 3, there were 48 subjects with positive cultures, with majority of microorganisms identified as *Klebsiella pneumoniae* in 13 cases, followed by *Acinetobacter baumannii*. Meanwhile, negative blood cultures were found in 68 neonates.

Table 3.
Culture Results based on Microorganism

| Microorganisms | f (%) |
|---|---|
| *Acinobacter baumanii* | 8 |
| *Klebsiella pneumoniae* | 13 |
| *Bacillus cereus* | 3 |
| *Pseudomonas oryzihabitans* | 1 |
| *Pseudomonas putida* | 1 |
| *Enterobacter clocae complex* | 3 |

| Microorganisms | f (%) |
|---|---|
| *Pseudomonas aeruginosa* | 3 |
| *Acinobacter soil* | 1 |
| *Staphycoccus epidermidis* | 2 |
| *Burkholderia multivorans* | 1 |
| *Burkholderia cepacia complex* | 2 |
| *Escherichia coli* | 3 |
| *Corynebacterium amycolatum* | 2 |
| *Salmonella spp* | 1 |
| *Staphylococcus haemolotycus* | 2 |
| *Staphylococcus aureus* | 1 |
| *Pantoea dispersa* | 1 |
| No bacterial growth | 68 |



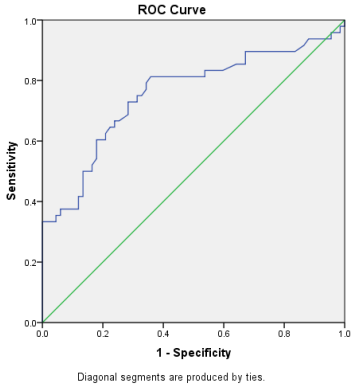




Based on the diagnostic test comparing platelet counts with the gold standard (blood culture), the sensitivity was 39.58% and specificity was 17.91%.

Table 4.
Platelet Count Diagnostic Analysis

| Platelet Indices | | Gold Standard | | n |
|---|---|---|---|---|
| | | Positive Culture | Negative Culture | |
| Platelet Count | < 304.500 | 19 | 55 | 74 |
| | ≥ 304.500 | 29 | 12 | 41 |

The PPV and NPV were 25.67% and 29.2%, respectively. The AUC value for platelet counts as a predictor of sepsis was 0.755.



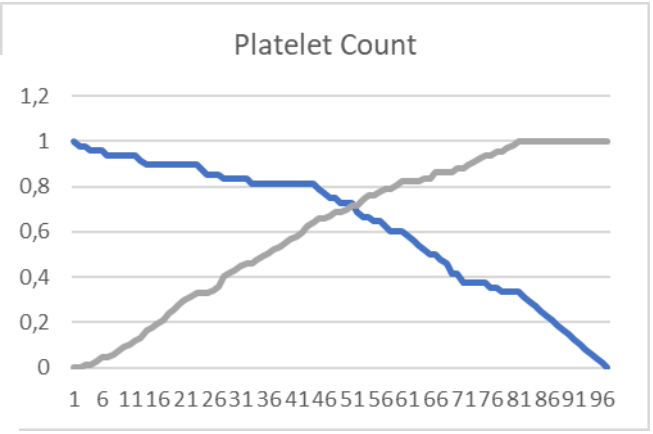



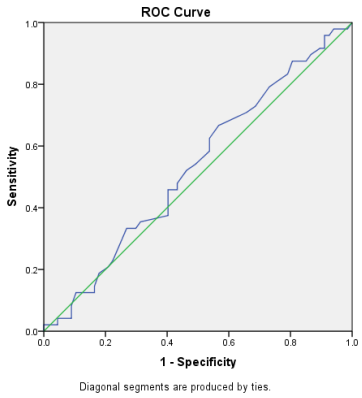

Figure 1. Platelet Count ROC, Sensitivity, and Specificity Curve

Based on the diagnostic test comparing MPV values with the gold standard test (blood culture), the sensitivity was 18.75% and the specificity was 82.08%.

Table 5.
Mean MPV Diagnostic Analysis

| Platelet Indices | Gold Standard | | n |
|---|---|---|---|
| | Positive Culture | Negative Culture | |
| MPV ≥ 11,45 | 9 | 12 | 21 |
| < 11,45 | 39 | 55 | 94 |

The PPV and NPV were 42.85% and 58.51%, respectively. The AUC value for MPV testing as a predictor of sepsis was 0.532.



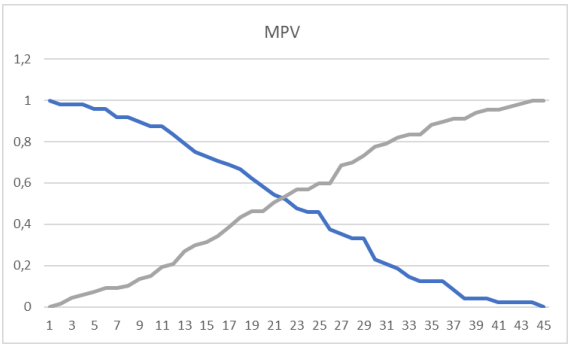



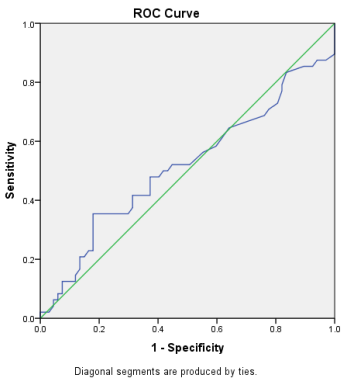

Figure 2. Mean MPV ROC, Sensitivity, and Specificity Curve

Based on the diagnostic test of PDW values compared to the gold standard test (blood culture), the sensitivity was 35.41% and the specificity was 82.08%.

Table 6.
Mean PDW Diagnostic Analysis

| Platelet Indices | Gold Standard | | n |
|---|---|---|---|
| | Positive Culture | Negative Culture | |
| PDW ≥ 12,05 | 17 | 12 | 21 |
| < 12,05 | 31 | 55 | 94 |
| Total | 48 | 67 | 115 |

The PPV and NPV values were 58.62% and 63.95%, respectively. The AUC value for PDW as a predictor of sepsis was 0.515.



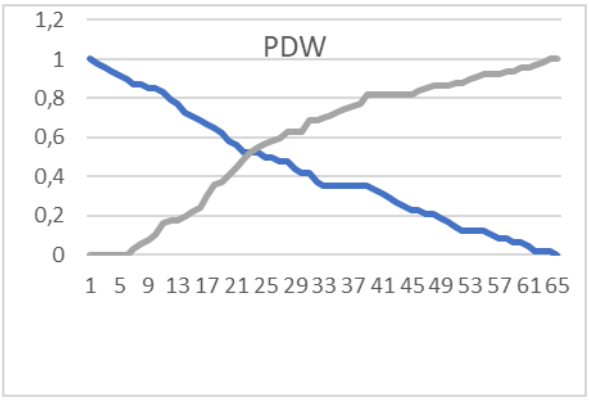




Figure 3. Mean MPV ROC, Sensitivity, and Specificity Curve

## DISCUSSION

This study observed 115 subjects, with more females than males found across various groups. Most subjects were born via cesarean section (SC) at a rate of 79.13%. Previous studies show differing results regarding the method of birth and its association with neonatal sepsis (Leibovitch et al., 2024; Rohadi et al., 2020; Salama & Tharwat, 2023; Utomo et al., 2022). The most common early clinical sign in this study was respiratory distress, present in 73.91% of the subjects. A significant portion were suspected of early-onset sepsis, while 40 were suspected of late-onset sepsis (Babji et al., 2021). Research indicates that low birth weight is a risk factor for neonatal sepsis, but this study found no such relationship, potentially due to the lower number of low-birth-weight subjects

(Abdelfattah et al., 2025; Ree et al., 2017). Gestational age also showed no correlation with neonatal sepsis in this study and others (Leibovitch et al., 2024; Ree et al., 2017; Septiane et al., 2022).

The average platelet count in subjects without sepsis was 310,500, while those with sepsis had an average of 168,000. This aligns with a study by Leibovitch et al. in 2024, which found the mean platelet count in sepsis cases to be 190,000, compared to 368,000 in the control group. Research indicates that a decrease in platelet count in sepsis is linked to systemic inflammatory response (Arshad et al., 2024; Leibovitch et al., 2024). However, a 2023 study found no significant difference in platelet counts between sepsis and non-sepsis subjects (Wilar et al., 2023). The study also noted that MPV and PDW values did not significantly differ between positive and negative cultures. MPV reflects platelet size; an unchanged MPV in thrombocytopenia suggests a lack of bone marrow stimulation (Septiane et al., 2022; Toro-Huamanchumo et al., 2022). PDW is less commonly used to predict neonatal sepsis, but some studies show varying results (Mevundi & S, 2021; O'Reilly et al., 2022).

In this study, the most common microorganism found in neonatal sepsis at RSUP H. Adam Malik is Klebsiella pneumoniae. Irsyad et al. also identified Klebsiella pneumoniae as the leading bacterium in stroke patients. Other studies found varying results, with Staphylococcus and Candida albicans being notable in different locations. In a diagnostic study, it is crucial to evaluate the sensitivity and specificity of a test method. Sensitivity indicates how well a tool detects a disease, while specificity shows its ability to identify a healthy subject (Sastroasmoro, 2021). In this research, the sensitivity and specificity of platelet count as a predictor for neonatal sepsis were 39.58% and 17.91%, respectively (Rohadi et al., 2020). The positive predictive value (PPV) was 25.67%, and the negative predictive value (NPV) was 29.2%. This low value indicates that using platelet count with a threshold of 304,500, only 25.67% of infants identified have neonatal sepsis. Other studies reported higher specificity and sensitivity values, suggesting that adjusting the threshold or increasing sample size could improve the test's performance (Abdelfattah et al., 2025). Currently, platelet count shows low sensitivity and specificity as a predictor for neonatal sepsis.

In this study, the Mean Platelet Volume (MPV) showed low sensitivity at 18.75% but high specificity at 82.08%. The Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were 42.85% and 58.51%, respectively. The results suggest that while MPV may serve as a diagnostic tool, it should be used alongside other tests. The threshold value for MPV was set at 11.45. Other studies indicated varying sensitivity and specificity, emphasizing the need to choose threshold values carefully, as higher thresholds can lower test sensitivity (Rohadi et al., 2020; Toro-Huamanchumo et al., 2022). This study found that the specificity and sensitivity of Platelet Distribution Width (PDW) as a predictor for neonatal sepsis were 82.08% and 35.41%, respectively. These values were higher—especially the sensitivity—than those of Mean Platelet Volume (MPV), making PDW the most sensitive among the three parameters tested. The positive and negative predictive values (PPV and NPV) of PDW were also relatively high at 58.62% and 63.59%, using a cutoff value of 12.05. In contrast, Abdelfattah et al. reported PDW as having the lowest sensitivity and specificity among the tested parameters, with values of 68% and 79%, using a cutoff of 12.5 (Abdelfattah et al., 2025). Rohadi et al. used a higher cutoff of 16.8 fL, yielding a very high specificity of 97% but a very low sensitivity of 7.1% (Rohadi et al., 2020). Overall, current research shows varying results regarding the sensitivity and specificity of platelet indices in predicting neonatal sepsis. Therefore, using a combination of tests is recommended for more accurate results.

## CONCLUSION

Majority of patients were female, with cesarean section being the most common delivery method. Early-onset sepsis occurred in 65.21% of patients. Risk factors included prolonged rupture of membranes and low birth weight in neonates. Positive cultures were found in 48 samples, mainly

Klebsiella pneumonia. Platelet counts, MPV, and PDW were measured with varying sensitivities and specificities for predicting sepsis, with platelet count showing the highest AUC of 0.755.

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