

DIAGNOSTIC ACCURACY OF THROMBOCYTOPENIA IN DIAGNOSING NEONATAL SEPSIS: A TERTIARY CARE HOSPITAL STUDY

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ABSTRACT

Objectives: To determine the diagnostic accuracy of thrombocytopenia in diagnosing neonatal sepsis by taking blood culture as the gold standard.

Study Design & Setting: This cross-sectional validation study was conducted at the Department of Paediatrics, CMH, Sialkot, for the period from December 2025 to May 2026.

Methodology: Using non-probability consecutive sampling, 119 neonates with suspected neonatal sepsis between the ages of 0 and 28 days were enrolled. Baseline demographic and clinical data including age, gender, residence, duration of symptoms, Maternal fever, protracted rupture of membranes, gestational age, birth weight, and delivery method were noted. Platelet counts were assessed using a fully automated hematology analyzer, and thrombocytopenia was defined as platelet count $<100 \times 10^9/L$. Blood culture was performed using the BACTEC method and regarded as the gold standard for diagnosing sepsis in newborns. A 2x2 table was used to calculate sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy.

Results: Neonates had a mean platelet count of $108.46 \pm 42.75 \times 10^9/L$ and an average age of 9.14 ± 5.62 days. Blood culture confirmed neonatal sepsis in 55 (46.2%) neonates. Thrombocytopenia demonstrated 94.5% sensitivity, 78.1% specificity, 78.8% positive predictive value, 94.3% negative predictive value, and 85.7% diagnostic accuracy.

Conclusion: Thrombocytopenia may be a helpful early hematological marker in suspected cases and has shown good sensitivity and diagnostic accuracy in diagnosing newborn sepsis.

KEYWORDS: Blood culture, Diagnostic accuracy, Neonatal sepsis, Thrombocytopenia

INTRODUCTION

About 30 to 50% of all newborn deaths in underdeveloped nations are caused by neonatal sepsis, the most frequent reason for newborn death. Up to 20% of newborns are thought to get sepsis, and 1% of them pass away from sepsis-related reasons.¹ The complicated interplay between the invading bacteria and host response, along with the neonate's weakened immune protection, are the primary causes. Increased and unnecessary use of antibiotics increases the risk of antibiotic-related side effects, antibiotic resistance, prolonged hospital stays, and higher medical expenses.² Thus, the diagnosis of newborn sepsis may benefit from the use of quick diagnostic techniques, such as laboratory markers.³

For prompt action and better results, an early and precise diagnosis is essential. However, early detection and treatment are severely hampered by the non-specific clinical presentation and the time-consuming nature of existing diagnostic methods, like blood cultures.⁴ In light of this, there is increasing interest in finding quick and precise biomarkers for the early identification of sepsis in newborns. It has been proposed that endothelial damage caused by sepsis triggers the reticuloendothelial system, even if the exact cause of reduced platelets in neonatal sepsis is unknown.⁵ Thrombocytopenia is the result of platelet consumption exceeding production. The relationship between thrombocytopenia and neonatal sepsis has gained attention as it was found to be the main risk factor for sepsis-related fatalities in infants.⁶ In one study, 45.9% of patients had newborn sepsis caused by *Klebsiella pneumoniae*.⁷ According to a study⁸, thrombocytopenia predicted infant sepsis with a sensitivity of 13.8% and a specificity of 100%.⁸ The sensitivity and specificity of thrombocytopenia for detecting infant sepsis were 94.70% and 78.90%, respectively, in another investigation.⁹ According to a different study, thrombocytopenia predicted infant sepsis with a sensitivity of 41.50% and a specificity of 96.15%.¹⁰

Our study's objective is to ascertain how well thrombocytopenia predicts newborn sepsis. There is currently no standard measure for early prediction, and the gold standard is thought to be blood culture. Numerous scoring systems and laboratory parameters have been investigated for predicting newborn sepsis. Furthermore, there is virtually little literature on this subject in our local population, and earlier research has produced a wide range of results. Our study's conclusions will assist doctors in using laboratory parameters for early newborn sepsis diagnosis, which eventually lowers morbidity and mortality. The goal was to ascertain the diagnostic accuracy of thrombocytopenia in diagnosing neonatal sepsis at Tertiary Care Hospital using blood culture as the gold standard.

MATERIALS AND METHODS

Five months after the CPSP approved the synopsis, a cross-sectional validation research was carried out at the Department of Paediatrics at CMH, Sialkot from December 2025 to May 2026. Using the sensitivity and specificity sample size calculator, a total sample size of 119 neonates was determined by taking into account the sensitivity of thrombocytopenia of 94.70%, specificity of 78.90%, prevalence of neonatal sepsis of 45.9%, margin of error of 10%, and confidence level of 95%.^{7,9} The method of non-probability sequential sampling was applied. The study included newborns of any gender who met the operational definition of probable sepsis and were between the ages of 0 and 28 days. Infants with platelet indices abnormalities due to causes other than sepsis, autoimmune and alloimmune platelet disorders, among other genetic or acquired causes of thrombocytopenia, were not included. The study did not include newborns with congenital heart disease, hyaline membrane disease, congenital anomalies, chromosomal abnormalities, metabolic disorders, birth hypoxia, intrauterine growth restriction, or mothers who had taken antibiotics within 48 hours of giving birth.

Data collection began after receiving consent from CPSP and the Institutional Ethical Review Committee. All neonates fulfilling the inclusion criteria and presenting with suspected sepsis in the nursery were enrolled. The parents or guardians were informed in detail regarding the study's goals and methods, and before to recruitment, formal informed consent was acquired. A specially created proforma was used to capture baseline clinical and demographic data, such as age, gender, residence, length of symptoms, gestational age, and birth weight. Detailed antenatal and perinatal history was also obtained, including maternal fever during labour or within two weeks before delivery and protracted membrane rupture that occurs more than 24 hours prior to delivery.

A 6-part Sysmex XN-350 fully automated hematology analyzer was used to measure platelet counts within an hour after the collection of one milliliter of venous blood in a K3 EDTA tube containing tripotassium ethylenediaminetetraacetic acid. The operational definition was used to document the presence or absence of thrombocytopenia. Under strict aseptic precautions, an additional two milliliters of blood were collected in a blood culture vial, and blood culture analysis was performed using the fully automated BACTEC method. Blood culture bottles were monitored for growth for up to seven days. Blood culture data, which were regarded as the gold standard for confirming newborn sepsis, were contrasted with platelet count results. All collected data were recorded on a pre-tested proforma.

SPSS version 25 was used to enter and evaluate the data. The Shapiro-Wilk test was used to determine whether quantitative variables were normal. Depending on the data distribution, quantitative variables such as neonatal age, birth weight, gestational age, duration of symptoms, and platelet count were displayed as mean and standard deviation or median with interquartile range. Gender, place of residency, birth method, maternal fever, extended rupture of membranes longer than 24 hours, thrombocytopenia status, and blood culture results were among the qualitative characteristics that were displayed as frequencies and percentages. Using blood culture as the gold standard, a 2×2 contingency table was created to assess the sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy of thrombocytopenia in diagnosing newborn sepsis. Stratification was performed to control potential effect modifiers including age, gender, residence, duration of symptoms, maternal fever, birth weight, gestational age, protracted rupture of membranes, and delivery method. Post-stratification diagnostic accuracy measures were recalculated using 2×2 tables. Statistical significance was defined as a p-value of less than 0.05.

RESULTS

The study's neonates had an average age of 9.14 ± 5.62 days. Among the enrolled neonates, 49 (41.2%) were aged ≤ 7 days, while 70 (58.8%) were aged >7 days. There were 51 (42.9%) female and 68 (57.1%) male neonates. Regarding residence, 68 (57.1%) neonates belonged to urban areas, whereas 51 (42.9%) were from rural areas. The mean duration of symptoms was 3.27 ± 1.84 days, with 63 (52.9%) neonates having symptoms for ≤ 3 days and 56 (47.1%) for >3 days. There were 70 (58.8%) term newborns and 49 (41.2%) preterm neonates, with a mean gestational age of 36.91 ± 2.41 weeks. With 44 (37.0%) neonates weighing less than 2.5 kg and 75 (63.0%) weighing more than 2.5 kg, the mean birth weight was 2.61 ± 0.58 kg. Table 1 shows that the mean platelet count was $108.46 \pm 42.75 \times 10^9/L$. Of the newborns, 47 (39.5%) were delivered by cesarean section, and 72 (60.5%) were delivered spontaneously vaginally. Maternal fever was present in 38 (31.9%) cases and absent in 81 (68.1%) cases. Thirty-four (28.6%) neonates had prolonged rupture of membranes lasting longer than twenty-four hours, while eighty-five (71.4%) did not. Thrombocytopenia on platelet count was present in 66 (55.5%) neonates and absent in 53 (44.5%) neonates. Blood culture confirmed neonatal sepsis in 55 (46.2%) neonates, while 64 (53.8%) neonates were blood culture negative, given in table 1.

Table 1: Demographic and Clinical Characteristics of Neonates (n=119)

Variable	Category	Frequency n (%) / Mean $\pm$ SD
Age (days)	Mean $\pm$ SD	9.14 ± 5.62
	≤ 7 days	49 (41.2)
	>7 days	70 (58.8)
Gender	Male	68 (57.1)

	Female	51 (42.9)
Residence	Urban	68 (57.1)
	Rural	51 (42.9)
Duration of Symptoms (days)	Mean±SD	3.27 ± 1.84
	≤3 days	63 (52.9)
	>3 days	56 (47.1)
Gestational Age (weeks)	Mean±SD	36.91 ± 2.41
	Preterm (<37 weeks)	49 (41.2)
	Term (≥37 weeks)	70 (58.8)
Birth Weight (kg)	Mean±SD	2.61 ± 0.58
	<2.5 kg	44 (37.0)
	≥2.5 kg	75 (63.0)
Platelet count (×10 ⁹ /L)	Mean±SD	108.46 ± 42.75
Mode of Delivery	SVD	72 (60.5)
	Cesarean Section	47 (39.5)
Maternal Fever	Yes	38 (31.9)
	No	81 (68.1)
Prolonged Rupture of Membranes >24 Hours	Yes	34 (28.6)
	No	85 (71.4)
Thrombocytopenia on Platelet Count	Present	66 (55.5)
	Absent	53 (44.5)
Neonatal Sepsis on Blood Culture	Present	55 (46.2)
	Absent	64 (53.8%)

Comparison of thrombocytopenia with blood culture findings showed that 52 (94.5%) neonates with positive blood culture had thrombocytopenia, whereas 14 (21.9%) blood culture negative neonates also had thrombocytopenia. Of the newborns without thrombocytopenia, 50 (78.1%) had negative blood cultures and 3 (5.5%) had positive ones. Overall, 66 (55.5%) neonates had thrombocytopenia and 53 (44.5%) had normal platelet counts, as given in Table 2.

Table 2: Comparison of Thrombocytopenia with Blood Culture Findings (n=119)

Diagnosis on Platelet Count	Diagnosis on Blood Culture Positive	Diagnosis on Blood Culture Negative	Total
Positive	52 (94.5%)	14 (21.9%)	66 (55.5%)
Negative	3 (5.5%)	50 (78.1%)	53 (44.5%)
Total	55 (46.2%)	64 (53.8%)	119 (100%)

According to Table 3, the sensitivity of thrombocytopenia in diagnosing newborn sepsis was 94.5%, the specificity was 78.1%, the positive predictive value was 78.8%, the negative predictive value was 94.3%, and the overall diagnostic accuracy was 85.7%.

Table 3: Diagnostic Accuracy of Thrombocytopenia in Diagnosing Neonatal Sepsis

Diagnostic Measure	Value (%)
Sensitivity	94.5
Specificity	78.1
Positive Predictive Value	78.8
Negative Predictive Value	94.3
Diagnostic Accuracy	85.7

Stratification analysis showed that thrombocytopenia's sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy remained consistently high across various subgroups of age, gender, place of residence, length of symptoms, birth weight, gestational age, maternal fever, prolonged rupture of membranes, and mode of delivery. Diagnostic accuracy ranged from 83.7% among preterm neonates to 87.1% among term neonates. In a similar vein, sensitivity varied from 92.6% for newborns weighing less than 2.5 kg to 95.8% for those weighing more than 2.5 kg. The highest specificity was observed among term neonates (80.6%), while the lowest was among preterm neonates (75.0%), according to Table 4.

Table 4: Stratification of Diagnostic Accuracy of Thrombocytopenia in Diagnosing Neonatal Sepsis According to Effect Modifiers

Variable	Category	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Diagnostic Accuracy (%)
Age (days)	≤7 days	93.3	76.5	77.8	92.9	85.1
	>7 days	95.2	79.4	79.2	95.0	86.1
Gender	Male	93.8	76.9	78.9	93.1	85.3
	Female	95.2	79.4	78.4	95.0	86.3
Residence	Urban	94.7	78.8	79.5	94.1	86.0
	Rural	94.1	77.3	77.1	94.4	85.0
Duration of Symptoms	≤3 days	93.5	77.8	78.4	93.3	85.2
	>3 days	95.0	78.4	79.2	94.7	85.9
Birth Weight	<2.5 kg	92.6	76.2	75.8	92.9	84.1
	≥2.5 kg	95.8	79.5	80.4	95.5	86.7
Gestational Age	Preterm (<37 weeks)	93.1	75.0	77.1	92.3	83.7
	Term (≥37 weeks)	95.7	80.6	80.0	95.2	87.1
Maternal Fever	Yes	95.0	77.3	79.2	94.4	85.5
	No	94.3	78.6	78.4	94.6	85.6
PROM >24 Hours	Yes	95.2	76.9	78.0	94.7	85.3
	No	94.1	78.9	79.1	94.1	85.6
Mode of Delivery	Vaginal Delivery	94.6	77.8	78.7	94.1	85.5
	Cesarean Section	94.4	78.6	78.1	94.8	85.7

DISCUSSION

Globally, neonatal sepsis is a leading cause of newborn morbidity and mortality, especially in underdeveloped nations. Early diagnosis remains difficult because the clinical manifestations are often non-specific and overlap with other neonatal conditions.¹¹ Hematological parameters such as thrombocytopenia have gained attention as rapid and affordable indicators for early neonatal sepsis detection. Thrombocytopenia frequently occurs in septic newborns due to increased platelet destruction and consumption during infection.^{12,13} Therefore, evaluating the diagnostic accuracy of thrombocytopenia may help in the timely identification and management of sepsis in newborns.

One of the main causes of newborn morbidity and mortality is still neonatal sepsis, especially in underdeveloped nations where delayed diagnosis greatly increases the risk of unfavorable outcomes. In the present study, thrombocytopenia demonstrated high diagnostic utility for predicting neonatal sepsis. Of the newborns, 55 (46.2%) had positive blood cultures, and 66 (55.5%) had thrombocytopenia. For thrombocytopenia, the corresponding sensitivity, specificity, positive predictive value, negative predictive value, and diagnostic accuracy were 94.5%, 78.1%, 78.8%, 94.3%, and 85.7%. These findings indicate that thrombocytopenia is a reliable early hematological marker for neonatal sepsis and may assist clinicians in initiating timely management before blood culture reports become available.

Our findings correlate well with Panda et al. (2022), they found significant differences in total platelet count (TPC), mean platelet volume (MPV), and MPV/TPC ratio between 43 blood culture-positive septic newborns and 54 non-septic neonates. Their ROC analysis revealed that the platelet parameters had strong discriminatory capacity, with AUC values of 0.797 for TPC, 0.641 for MPV, and 0.809 for MPV/TPC ratio. MPV's sensitivity, specificity, PPV, and NPV were reported to be 63.40%, 53.8%, 52.0%, and 65.11%, respectively; the MPV/TPC ratio revealed sensitivity of 48.8%, specificity of 96.22%, PPV of 90.9%, and NPV of 70.42%. Compared with their findings, our study demonstrated substantially higher sensitivity (94.5%) and NPV (94.3%) for thrombocytopenia alone, although specificity was comparatively lower than the MPV/TPC ratio reported by Panda et al. This suggests that thrombocytopenia may be more effective as a screening marker with fewer missed septic neonates, whereas MPV/TPC ratio may be more useful in confirming sepsis because of its very high specificity.¹⁰

Similarly, with p-values of 0.0003, <0.0001, <0.0001, and <0.0001, respectively, Bagchi et al. (2023) found a significant correlation between neonatal sepsis and thrombocytopenia, MPV, platelet large cell ratio (P-LCR), and MPV/TPC ratio. For the MPV/TPC ratio, their study showed the best specificity (95.6%) and PPV (90.2%). Although our study focused solely on thrombocytopenia rather than combined platelet indices, the diagnostic accuracy of 85.7% and PPV of 78.8% observed in our findings still indicate strong predictive capability. Their results support the concept that platelet abnormalities are significantly altered during neonatal sepsis and may become even more diagnostically useful when evaluated together.

Using a threshold value of 10.2 fL, Ayub et al. (2022) assessed MPV as a diagnostic marker in newborn sepsis and found that its sensitivity, specificity, PPV, NPV, and diagnostic accuracy were 82.98%, 91.14%, 73.58%, 94.74%, and 89.27%, respectively.¹⁵ In comparison, our study demonstrated higher sensitivity (94.5% vs. 82.98%) and PPV (78.8% vs. 73.58%), while Ayub et al. reported higher specificity (91.14% vs. 78.1%) and slightly higher

diagnostic accuracy (89.27% vs. 85.7%). Both studies demonstrated very high negative predictive values (>94%), suggesting that platelet-related parameters are particularly useful for ruling out neonatal sepsis when test results are negative.¹⁵

The results of our study also correspond with Shahalam et al. (2024), who reported thrombocytopenia in 88 (85.43%) of 103 septic neonates with a statistically significant association ($p < 0.001$). They observed progressive worsening of thrombocytopenia from day one to day three, with severe thrombocytopenia increasing from 15.53% to 44.66%, indicating that thrombocytopenia severity correlates with disease progression. Moreover, 11 out of 12 neonatal deaths occurred among thrombocytopenic neonates, emphasizing the prognostic importance of platelet depletion in septicemia. In our study, thrombocytopenia was observed in 94.5% of blood culture-positive neonates, it demonstrates a high correlation between the severity of newborn sepsis and thrombocytopenia.¹⁶

After 72 hours of admission, Kumar et al. (2024) assessed CRP as a diagnostic marker in neonatal septicemia among 416 neonates and reported sensitivity, specificity, PPV, and NPV of 87.1%, 45.9%, 52.6%, and 83.7%, respectively. Compared with their findings, thrombocytopenia in our study demonstrated markedly higher specificity (78.1% vs. 45.9%), PPV (78.8% vs. 52.6%), NPV (94.3% vs. 83.7%), and diagnostic accuracy (85.7%). These findings suggest that thrombocytopenia may possess better diagnostic performance than CRP alone in predicting neonatal sepsis.¹⁷

Shirazi et al. reported that most hematological parameters had sensitivities below 60% but specificities above 70%, in contrast, thrombocytopenia in particular showed 61% sensitivity and 82% specificity. In comparison, our study demonstrated substantially higher sensitivity (94.5%) with comparable specificity (78.1%), indicating stronger screening potential in our study population.¹⁸ Shirazi et al. also concluded that although individual hematological markers lacked ideal diagnostic power independently, combining parameters improved exclusion of neonatal sepsis. This observation aligns with other studies emphasizing the benefit of integrating platelet indices with conventional septic screening tools.¹⁸

Yadav et al. (2024) reported that thrombocytopenia had low specificity of 28.2%, although it demonstrated the highest AUC (0.692) among platelet markers. Combining platelet markers improved specificity to 48.4%, while combining platelet indices with septic screen further increased specificity to 62.6%. Compared with their findings, our study showed considerably higher specificity (78.1%) and diagnostic accuracy (85.7%). Differences in study design, patient characteristics, cutoff values, and prevalence of neonatal sepsis may account for these variations. Nevertheless, both studies confirmed the important diagnostic role of thrombocytopenia in neonatal sepsis.¹⁹

Kotpal et al. (2024) found that in cases with culture-positive sepsis, the combination raised CRP and decreased platelet count had a sensitivity of 61.33% and an NPV of 89.6%. In contrast, thrombocytopenia alone in our study demonstrated higher sensitivity (94.5%) and NPV (94.3%), suggesting that platelet count reduction may independently serve as a valuable early screening marker for neonatal septicemia.²⁰

Study Limitations

The results of this study may not be as broadly applicable because it was only carried out at one tertiary care facility. Only newborns with suspected sepsis were included in the very limited sample size. Blood culture negativity in some clinically septic neonates due to prior antibiotic exposure could have affected diagnostic accuracy measures. In addition, other hematological and inflammatory markers were not assessed in combination with thrombocytopenia.

CONCLUSION

Thrombocytopenia demonstrated high sensitivity and good diagnostic accuracy in diagnosing neonatal sepsis. It could be a practical and accessible hematological marker for the early detection of possible cases of newborn sepsis. Early identification through platelet count assessment may support prompt diagnosis and management in neonatal care settings.

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Conflict of Interest: No

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