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ORIGINAL RESEARCH

A comparative analysis of platelet characteristics in preterm versus full-term neonates

Dr. Sudha M[1], Dr. A. Sandilyan[2], Dr. A.Vijay[3], Dr. Shanmugapriya. M[4]

[1]Associate Professor, Department of Pathology, ACS Medical College and Hospital, India
[2]Assistant Professor, Department of Pathology, Melmaruvathur Adhiparasakthi Institute of Medical Sciences & Research Institute, India
[3]Professor, Department of Pathology, St Peter's Medical College Hospital and Research Institute-Hosur-635130, Krishnagiri, India
[4]Professor, Department of Pathology, Meenakshi Medical College Hospital and Research Institute Enathur, Kanchipuram, India

Corresponding Author
Dr. A.Vijay
Professor, Department of Pathology, St Peter's Medical College Hospital and Research Institute-Hosur- 635130, Krishnagiri, India
Email: vjpath@gmail.com

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ABSTRACT
Platelets are vital for maintaining hemostasis and vascular integrity, especially in neonatal patients who are in a critical stage of development. It is important to understand the complex mechanisms of platelet production, function, and regulation in neonates to ensure the best health outcomes for this population. In our study, we focused on neonates born at the PES Institute of Medical Sciences and Research, as well as those referred for specialized care. We measured platelet counts and related indices for 140 neonates using automated analyzers, and we collected a detailed clinical history for each newborn. Neonatal blood was drawn into single-use collection tubes with K2 EDTA.
The automated haematology analyser, SYSMEX XS-1000i, provided the platelet indices.
In our study, the frequency of full-term neonates and preterm neonates were 115 and 25 respectively. The current study found that 23.6% of neonates had decreased PC, 1.4% had an increased count, and 75% had normal values. In our study,we found that there were no statistically significant differences between the MPV, PDW, and PCT values of full-term and preterm infants.
Regularly monitoring platelet levels is essential in neonatal care, helping to quickly identify potential issues and prevent serious complications. This proactive approach ensures that vulnerable infants receive the attention they need, allowing healthcare providers to take prompt action and giving newborns a better chance at a healthy start.
Keywords: Platelet count(PC), Mean platelet volume(MPV), Platelet distribution width (PDW).

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INTRODUCTION

Automation in laboratory analysis has resulted in more accurate and timely results, as well as the ability to measure hitherto unknown factors. The whole blood count analyser may calculate platelet indices in addition to the count. Platelet indices provide useful information regarding the morphology and maturity of platelets. Platelets, also known as thrombocytes, are tiny cells that play a crucial role in the blood clotting process. Produced in the bone marrow, platelets circulate in the blood and help in stopping bleeding by forming a clot at the site of injury. While platelet production in adults is a relatively well-studied process, the same cannot be said for neonates, or babies in the first 28 days of life(1,2).

The process of platelet production, also known as thrombopoiesis, starts with hematopoietic stem cells (HSCs) in the bone marrow. These stem cells have the ability to develop intodifferent types of blood cells, including platelets. In neonates, the number of these stem cells is significantly higher than in adults, which is why the platelet count is generally higher in newborns.The production of platelets is regulated by a hormone called thrombopoietin (TPO). TPO stimulates HSCs to differentiate into megakaryocytes, the precursor cells of platelets. Megakaryocytes

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undergo a complex process of maturation, fragmentation, and release into the bloodstream, where they become functional platelets. In neonates, the maturation(3,4).Neonates have a unique physiology, and their platelet production differs from that of older children and adults. Understanding how platelets develop and function in neonates is essential as it can help in the early diagnosis and treatment of bleeding disorders in this vulnerable population.The platelet count measures the number of platelets in a specific volume of blood. However, there are other factors that need to be taken into consideration when evaluating the body's ability to form blood clots. This is where platelet indices come into play. Platelet indices are laboratory parameters that provide a more comprehensive assessment of platelets and their function.The three most common platelet indices are mean platelet volume (MPV), platelet distribution width (PDW), and platelet(3,4,5).

One of the key advantages of automation in laboratories is its ability to improve accuracy and precision. Human error is almost inevitable in any scientific process, but with automation, the risk of errors is significantly reduced. This is particularly crucial in fields like medical research, where even the slightest deviation in results can have significant consequences. By automating routine tasks, scientists can dedicate more time and energy to analyzing data and drawing meaningful conclusions.

MATERIALS AND METHODS

This prospective study examined neonates born at the PES Institute of Medical Sciences and Research, as well as additional neonatal patients referred for specialized disease management. Platelet counts and associated indices were determined for a cohort of 140 neonates utilizing automated haematology analyzers. Furthermore, a comprehensive clinical history of each newborn was meticulously collected.This study was conducted after obtaining full and informed consent from each patient and was approved by the Institutional Ethics Committee (IEC).

Inclusion criteria: Neonates born at PES Institute of Medical Sciences, both full-term and preterm.

Exclusion criteria: Children beyond the age of 28 days were excluded, as were inadequate, excess, haemolysed, clotted, and anticoagulated samples lasting more than two hours.

Methods: Neonatal blood was drawn into single-use collection tubes with K2 EDTA.

The automated haematology analyser, SYSMEX XS-1000i, provided the platelet indices.

Platelet indices reference values by SYSMEX XS-1000i Platelet Count ─ 150-400×10^9/L.

- Mean Platelet Volume (MPV) ─ 6.4-9.8 fl
- Platelet Distribution Width (PDW) ─ 10-18 fl
- Plateletcrit (PCT) ─ 0.1-0.5%

Statistical analysis: The statistical software tool SPSS, version 21, was used for the analysis. The groups were compared using a two-sample independent t-test (unpaired t-test). There was no statistical significance found between neonate platelet indices at full term and preterm.

RESULTS

Based on inclusion and exclusion criteria, 140 neonates (0–28 days) in total were included in our study. According to their term and maternal status, the study was conducted.In our study, the frequency of full-term neonates and preterm neonates were 115 and 25 respectively (Table 1).

Table 1: Frequency table based on term

Variable	Frequency	Percentage (%)
Full Term	115	82.1
Preterm	25	17.9

The study involved a detailed analysis of platelet parameters in a cohort of 140 neonates, with a focus on determining platelet count and its associated indices. The results revealed that 23.6% of the neonates exhibited decreased platelet counts, indicating potential thrombocytopenia, while only 1.4% presented with elevated platelet counts, suggesting thrombocytosis. The majority, at 75%, demonstrated normal platelet counts, reflecting a healthy haematological status. In terms of mean platelet volume (MPV), a significant finding was that 91.4% of neonates had increased MPV levels, which may suggest altered platelet production or activation processes. This was contrasted by 8.6% of the neonates who maintained MPV within normal parameters.

Platelet distribution width (PDW), a measure of platelet size variability, indicated that 5.7% of neonates fell below the established normal range, whereas a substantial 94.3% had PDW values that were within the expected limits, suggesting a consistent platelet population in most infants. Furthermore, platelet crit (PCT) assessment showed that 5.7% of the neonates had PCT values that were below the normal threshold. Conversely, 93.6% maintained normal PCT levels, and 0.7% exhibited elevated PCT, potentially reflecting increased platelet mass.

In summary, while the majority of neonates presented with normal platelet counts, PDW, and PCT, the elevated MPV levels raise intriguing considerations regarding platelet characteristics and neonatal health. These findings underscore the importance of monitoring platelet indices in neonates to identify early signs of haematological abnormalities. (Table 2).

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Table 2: Platelet indices distribution in percentage

Indices	Below Normal Frequency (%)	Normal Frequency (%)	Above Normal Frequency (%)
PC	33 (23.6)	105 (75)	2 (1.4)
MPV	-	12 (8.6)	128 (91.4)
PDW	8 (5.7)	132 (94.3)	-
PCT	8 (5.7)	131 (93.6)	1 (0.7)

In a study involving 115 full-term and 25 preterm newborns, the parameters of PC (platelet count), PDW (platelet distribution width), and PCT (plateletcrit) were mostly within normal ranges, while MPV (mean platelet volume) was elevated. Specifically, 90.4% of full-term infants and 96% of preterm infants exhibited increased MPV values. This indicates that both preterm and full-term newborns have higher MPV levels.(Table 3).

Table 3:Frequency of platelet Indices in Full Term and Preterm

FULL TERM	PC Frequency (%)	MPV Frequency (%)	PDW Frequency (%)	PCT Frequency (%)
BELOW NORMAL	25 (21.7)	-	7 (6.1)	7 (6.1)
NORMAL	88 (76.5)	11 (9.6)	108 (93.9)	107 (93)
ABOVE NORMAL	2 (1.7)	104 (90.4)	-	1 (0.9)
PRE TERM				
BELOW NORMAL	8 (32)	-	1 (4)	1 (4)
NORMAL	17 (68)	1 (4)	24 (96)	24 (96)
ABOVE NORMAL	-	24 (96)	-	-

In our study, we observed that full-term neonates had a higher percentage of PC (78.2%) compared to preterm neonates (68%), based on a sample of 115 full-term and 25 preterm neonates. However, the difference was not statistically significant. Additionally, when comparing the mean platelet volume (MPV), platelet distribution width (PDW), and platelet crit (PCT) between full-term and preterm infants, we found that these measurements were nearly equal and did not show any statistically significant differences.(Table 4).

Table 4: Platelet indices values of full-term and preterm neonates:

Parameters	Term		p-value
	Full term 115 (82.1%)	Preterm25 (17.9%)	
PC	205.4±77.8	194.28±70.72	0.512
MPV	10.73±0.75	10.86±0.82	0.444
PDW	12.11±1.77	12.46±1.58	0.355
PCT	0.21±0.07	0.21±0.08	0.714

DISCUSSION

Platelets, also known as thrombocytes, are the smallest cellular components found within the blood and are essential to the process of hemostasis, which is the biological mechanism that prevents excessive bleeding following vascular injury. These cells are produced in the bone marrow from large precursor cells termed megakaryocytes and typically have a lifespan ranging from seven to ten days in circulation.In the absence of injury, platelets circulate in a quiescent state within the bloodstream. However, upon detecting damage to a blood vessel—such as lacerations or ruptures—platelets become activated through a complex cascade of biochemical signals(1,2). This activation results in a change in morphology, allowing platelets to adhere to both the site of injury and to one another, culminating in the formation of a platelet plug that effectively mitigates blood loss.The mean platelet volume (MPV) is a critical clinical parameter that measures the average size of platelets present in the blood. MPV provides insights into the functionality of platelets, as larger platelets are generally more reactive and newer, while smaller platelets may indicate older or less functional cells. The analysis of MPV can yield important information regarding various platelet-related disorders and the efficiency of platelet production within the bone marrow.Decreased MPV readings may suggest several underlying health conditions, particularly those associated with impaired platelet production or thrombocytopenia, a condition characterized by a diminished platelet count. Such findings are instrumental for healthcare professionals in diagnosing various haematological disorders, vitamin deficiencies, and certain genetic conditions, thereby facilitating timely and targeted therapeutic interventions(3,4).

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The platelet count and size have a direct correlation with platelet crit (PCT). It is a useful screening method for identifying anomalies in the platelet quantitative state.Reactive thrombocytosis can be distinguished from myeloproliferative diseases using PCT and PDW.Full-term neonate is defined as a neonate born any time after 37 completed weeks of gestation and up until 42 weeks of gestation.The preterm neonate is defined as a neonate born before 37 completed weeks of gestation. of placental dysfunction may be responsible for a low platelet count in newborns at birth[30]. Platelets from preterm newborns demonstrated a decreased platelet adhesion as compared to full-term neonates, which was correlated to gestational age. The decreased platelet count and their reduced functions in relation to gestational age may result in a higher risk of bleeding tendency in preterm newborns(5,6,7).

Research by Arad ID et al.(8) demonstrated that both platelet count and mean platelet volume (MPV) were elevated in 155 newborns weighing more than 2 kg. This increase in MPV and platelet count is attributed to enhanced platelet synthesis during the first few weeks after birth. In a study conducted by Akira Fujinami et al. (9), the platelet count, MPV, and platelet distribution width (PDW) were examined in healthy children. They found that platelet count and MPV increase during the first week after birth, with PDW widening until the child reaches 1-6 months of age. In our study, we observed a rise in platelet count and MPV, although the changes were not statistically significant. Additionally, PDW remained normal in both preterm and full-term neonates.

Mukiibi JM et al(11). investigated platelet characteristics—including platelet count, mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (PCT)—in a sample of 600 healthy full-term newborns in Zimbabwe. They developed a reference model for this specific population. In a 1987 study, Patrick CH et al. analyzed cord blood samples from 143 healthy newborns and found that term neonates had significantly higher MPV and platelet counts compared to preterm neonates. Additionally, PDW was found to be lower in newborns. Recently, research has started to establish a connection between MPV and newborn sepsis. Studies by Shalaby[1] and Shaaban[2] found a substantial rise in MPV in infants with sepsis. These results suggested that a simple routine blood test for MPV can aid in the diagnosis and prognosis of sepsis in neonates.Thus, we conclude that MPV could be employed as a biomarker for the early detection of newborn sepsis.

According to the research conducted by Wasiluk et al., preterm newborns exhibit a greater proportion of platelet-derived microparticles than their full-term counterparts, which serves as a compensatory mechanism for the hemostatic system. In a comparative study undertaken in 2009, Wasiluk et al. evaluated blood platelet indices in both full-term and preterm infants. Their findings indicated that decreased platelet count (PC) and plateletcrit (PCT), as well as an increased platelet distribution width (PDW), may be attributed to a lower gestational age or to dysfunctions of megakaryocytes and the placenta.Patrick et al. (6) found that the mean platelet volume (MPV) values were higher in 78 (54.5%) full-term neonates compared to 65 (45.5%) preterm neonates, and this difference was statistically significant. In contrast, Silfeler et al. reported that MPV values were higher in 80 (57.97%) preterm neonates than in 58 (42.03%) full-term neonates. An increased MPV value indicates platelet consumption and activation27. In our study, however, there was no statistically significant difference in platelet count between 115 (82.1%) full-term neonates and 25 (17.9%) preterm neonates. Our findings are consistent with those of Silfeler et al(Table 5).

Table 5: Comparison of MPV significance in relation to the term

	Present study	Patrick CH et al[6]	Silfeler I et al[12]
p-value	0.444	0.001	0.0001

PDW significance aboutthe term was explained in the table below:

Table 6: Comparison of PDW significance aboutthe term:

	Present study	Patrick CH et al[6]	Wasiluk A et al[16]
p-value	0.355	0.05	0.0001

Significant differences in platelet distribution width values between full-term and preterm infants were identified in a study conducted by Patrick CH and colleagues in 1987. The findings revealed that 78 out of 143 full-term neonates (54.5%) exhibited smaller platelet distribution width values compared to 65 out of 143 preterm newborns (45.5%). This variation was statistically significant, indicating that gestational age may influence the maturation of platelets in neonates. These results underscore the importance of understanding hematological characteristics in infants to enhance clinical assessments and interventions. Furthermore, a study by Wasiluk A. et al. (2009) reported that 55 full-term newborns (51.8%) demonstrated significantly higher platelet distribution width values than their preterm counterparts (48.2%). This discrepancy further emphasizes the notable differences in platelet distribution between these two groups, which reached statistical significance(16).

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Plateletcrit significance withthe term was explained in the table below:

Table 7: Comparison of platelet crit significance withthe term

	Present study	Wasiluk A et al[14]
p-value	0.714	0.001

Wasiluk et al. (16) reported that platelet crit values were significantly higher in 55 full-term neonates (51.8%) compared to 48.2% in preterm neonates. However, the analysis indicated no statistically significant difference in platelet crit values between the cohort of 115 full-term neonates, representing 82.1% of the sample, and the 25 preterm neonates, which accounted for 17.9%. Furthermore, the study demonstrated that platelet distribution width values were consistent across both groups of neonates. These findings imply that, despite differences in gestational age, platelet metrics exhibited stability throughout the examined samples.

CONCLUSION

The evolution of automation in laboratory settings is revolutionizing the methodologies employed by healthcare providers in the analysis of platelet indices. With advancements in efficiency and precision, automated systems have become indispensable in contemporary haematology testing. The incorporation of robotic technologies and automated machinery within laboratories has significantly transformed the landscape of scientific experimentation. By executing tasks that were traditionally performed manually, these innovations markedly decrease the time required for experimental procedures. This heightened efficiency enables researchers to conduct a greater volume of experiments within reduced timeframes, thereby improving accuracy and minimizing the potential for human error. Consequently, the pace of scientific discovery is accelerated, fostering rapid progress in diverse fields, including medicine, materials science, and environmental research.

Our study reveals that platelet indices in neonates, including parameters such as platelet count, volume, and distribution width, do not exhibit significant differences when comparing preterm and full-term infants. These findings suggest that the maturation of platelet function may not be markedly influenced by gestational age. Nevertheless, further research is warranted to investigate the potential clinical implications and applications of platelet indices in neonatal care, as a deeper understanding could enhance diagnostic accuracy and inform treatment strategies for this vulnerable population.

Conflict of interest: The authors declare no conflict of interest.

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