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Original Research Article

A Study of Platelet Indices In Healthy And Sick Neonates

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Abstract

Introduction: The platelet number alone does not give a complete picture of platelet maturity and function. Therefore, platelet indices have been the subject of intensive study in recent years, but they have not been firmly established in the neonates. *Aims and objectives:* To determine the platelet indices in the healthy and sick neonates admitted in the department of paediatrics. *Methods:* It was a prospective study conducted in neonates born in PES institute of medical sciences and research and other neonatal cases referred for management of disease conditions. Platelet count and its indices were derived for total 140 neonates from the automated haematology analyser SYSMEX × s1000*i*. A detailed clinical history of neonates was obtained. *Results:* Out of 140 neonates, 84 (60%) male and 56 (40%) were female. There were no significant differences of platelet indices between healthy neonates 33 (23.6%) and sick neonates 107 (76.4%), between healthy full term 22 (66.7%) and sick full term 93 (6.9%), between healthy preterm 11 (33.3%) and sick preterm 14 (13.1%). *Conclusion:* These data indicate that platelet indices of neonates showed no significance in values between healthy neonates and sick neonates. Further studies will be needed in clinical application of platelet indices in neonates.

Keywords: Platelet indices; Neonates; Mean platelet volume (MPV).

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Introduction

Platelets are cytoplasmic fragments of megakaryocytes and are disc shaped without any nucleus, Golgi apparatus or endoplasmic reticulum. The average size of a platelet is 3.5 ± 0.7 μm with a thickness of 0.9 ± 0.3 µm with a volume of 7 ± 4.5 μl. The average platelet count ranges from 150–400 × 10^9/L which is accepted by most of the laboratories.[1] The platelet parameters analysed by various automated blood cell count analysers are Platelet count (PC), Mean platelet volume (MPV), Platelet distribution width (PDW), Plateletcrit (PCT) and Immature platelet fraction

(IFP). Platelet count in newborns are similar to those in adults with values of 150–400 × 10^9/L. The adult range of platelet count is reached in the foetus by its 2nd trimester. Mean platelet volume (MPV) is the measurement of average size of platelets found in blood. MPV results can be used to make inferences about platelet production in bone marrow or platelet problems.[2–5] Low MPV values primarily due to thrombocytopenia and also due to impaired platelet production.[2] Arad ID *et al* in 1988 demonstrated platelet count and mean platelet volume in 155 neonates with birth weight more than 2 kg and established that platelet count and MPV is increased due to increased production of platelets in post natal weeks.[6] Platelet distribution width (PDW) reflects the variability in platelet size and it is increased in platelet anisocytosis. MPV and IPF can play a role in the rapid evaluation of bone marrow activity.[1] PDW is useful in early detections of pathological conditions like bacteraemia, schistocytosis, platelet consumption or aggregation.[7] Plateletcrit (PCT) is directly related to the platelet count and size of the platelets. It is an effective screening tool for detecting platelet quantitative abnormalities. PCT and PDW can be used to differentiate reactive thrombocytosis from myeloproliferative disorders.[2] Reticulated platelets can be expressed as an immature platelet fraction, as the newly formed are more reactive than mature platelets.[2]

Materials and Methods

It was a prospective study conducted in neonates born in PES institute of medical sciences and research and other neonatal cases referred for management of disease conditions. Platelet count and its indices were derived for total 140 neonates from the automated haematology analysers. A detailed clinical history of neonates was obtained.

Inclusion criteria

Neonates (0–28 days) born in PES institute of medical sciences and referred cases for management of any disease conditions are included.

Exclusion criteria

Children older than 28 days of life. Inadequate, excess, haemolysed, clotted and anticoagulated samples more than two hours duration were excluded.

Blood from neonates was collected in disposable collection tubes containing K_2 EDTA. The platelet indices were derived from the SYSMEX × S- 1000*i* automated haematology analyser. Platelet indices reference values by SYSMEX × S-1000*i* are Platelet Count (150–400 × 10^9/L), Mean Platelet Volume (6.4–9.8 fl) and Platelet Distribution Width (10–18 fl) Plateletcrit (PCT)—0.1–0.5%

Statistical analysis was performed using SPSS statistical software package, version 21. Two sample Independent *t* test (Unpaired *t* test) was used to compare the groups. ONE WAY ANOVA and Kruskall Wallis test was used to compare disease status and platelet indices of neonates. (*p*-value <0.05), it was considered as statistically significant.

Results

A total of 140 neonates (0–28 days) were included in our study as per the inclusion and exclusion criteria. The study was done based on their gender, term and disease conditions. Out of 140 cases, number of sick neonates was more compared to healthy neonates (Table 1 and Fig. 1).

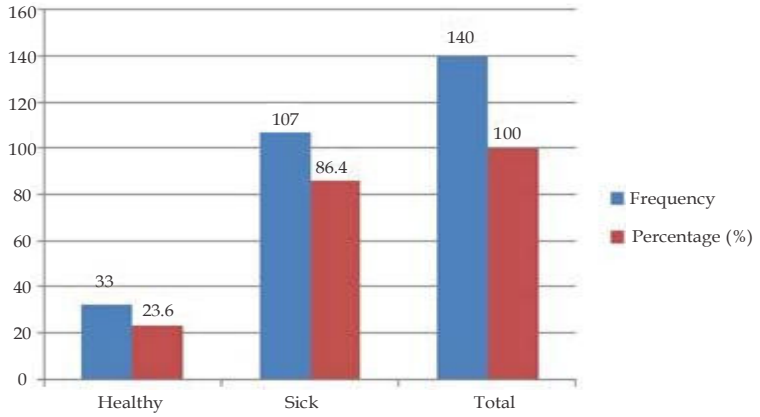

Fig 1: Comparison of number of sick neonates with healthy neonates

Table 1: Healthy and Sick neonates.

Disease status	Frequency	Percentage (%)
Healthy	33	23.6
Sick	107	86.4
Total	**140**	**100**

Out of 140 cases, 33 neonates were normal and 69, 31, 5 and 2 cases were suffered with birth asphyxia, meconium aspiration syndrome, sepsis and hyperbilirubinemia respectively (Table 2 and Fig. 2).

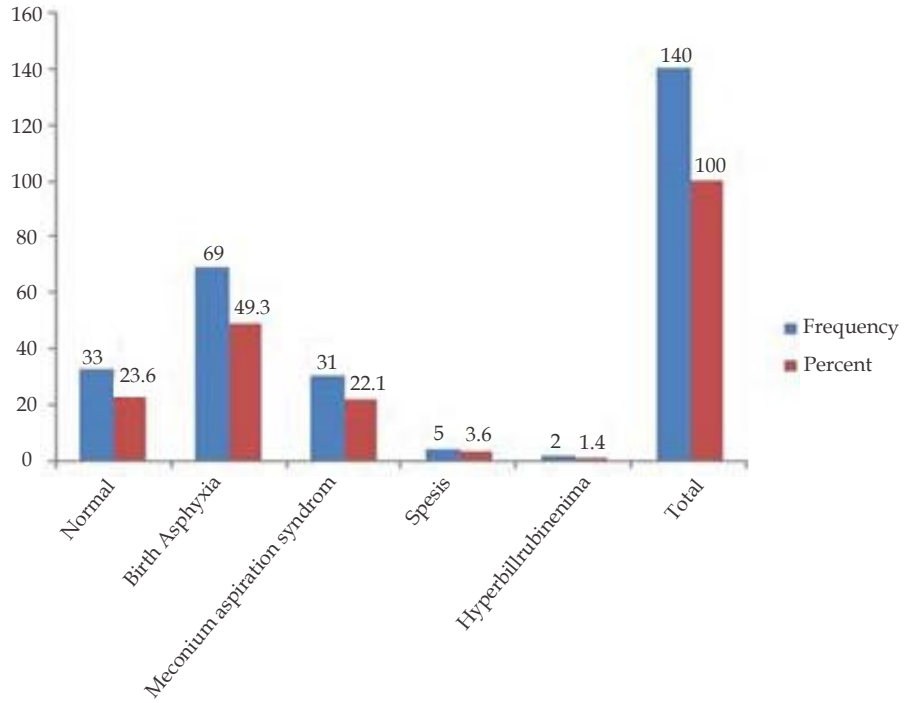

Fig 2: Distribution of individual disease status in neonates.

Table 2: Distribution of individual disease status in neonates.

Disease status	Frequency	%
Normal	33	23.6
Birth Asphyxia	69	49.3
Meconium aspiration syndrome	31	22.1
Sepsis	5	3.6
Hyperbilirubinemia	2	1.4
Total	**140**	**100.0**

Out of 84 male and 56 female neonates, birth asphyxia and meconium aspiration syndrome cases were seen predominantly (Table 3). Out of 115 full term and 25 preterm neonates, birth asphyxia and meconium aspiration syndrome were seen predominantly (Table 4).

Table 3: Distribution of disease conditions in relation to gender of the neonates

Gender of the neonates		Frequency	(%)
Male	Normal	16	19.0
	Birth Asphyxia	42	50.0
	Meconium aspiration syndrome	22	26.2

Gender of the neonates		Frequency	(%)
	Sepsis	3	3.6
	Hyperbilirubinemia	1	1.2
	Total	84	100.0
Female	Normal	17	30.4
	Birth Asphyxia	27	48.2
	Meconium aspiration syndrome	9	16.1
	Sepsis	2	3.6
	Hyperbilirubinemia	1	1.8
	Total	**56**	**100.0**

Table 4: Distribution of disease conditions in relation to term of the neonates:

Term	Disease	Frequency	(%)
Full-term	Normal	22	19.1
	Birth Asphyxia	61	53.0
	Meconium aspiration syndrome	26	22.6
	Sepsis	4	3.5
	Hyperbilirubinemia	2	1.7
	Total	**115**	**100.0**
Pre-term	Normal	11	44.0
	Birth Asphyxia	8	32.0
	Meconium aspiration syndrome	5	20.0
	Sepsis	1	4.0
	Total	**25**	**100.0**

As the data was not normally distributed an alternative test for ANOVA i.e., Kruskall Wallis test was used to compare the groups. And the *p*-value was 0.504, which was not statistically significant. So there was no difference between healthy and sick neonates in relation to platelet counts. (Table 5) ONE WAY ANOVA test was used to compare the disease in relation to MPV, PDW and PCT. As the *p*-value >0.05, there is no statistical significant difference between healthy neonates and sick neonates in relation to their gender and term.

Table 5: ANOVA TEST- Statistical evaluation of platelet indices in relation to their disease status

Disease	MPV	PDW	PCT
Birth asphyxia	0.45	0.74	0.99
Meconium aspiration syndrome	0.75	0.89	0.23
Sepsis	0.58	0.98	0.99
Hyperbilirubinemia	0.99	1.0	0.95

Discussion

The current study included 140 neonates based on their gender and term and compared with platelet parameters in relation to neonatal disease conditions. Infection is a frequent cause of thrombocytopenia in both term and preterm infants and should be ruled out in any ill-appearing newborn.[8] Bacterial sepsis causes thrombocytopenia by several mechanisms, including disseminated intravascular coagulation, endothelial damage, immune-mediated destruction, platelet aggregation due to bacterial products adhering to platelet membrane, and decreased platelet production from infected bone marrow. Viral infections in the perinatal period can cause severe thrombocytopenia, presumably a result of sialic acid loss from platelet membranes due to viral neuraminidase, intravascular platelet aggregation, and decreased production from degeneration of megakaryocytes.[8] Birth asphyxia is also associated with thrombocytopenia, although hypoxia alone does not appear to be sufficient to decrease platelets. Preterm infants can develop complications commonly associated with thrombocytopenia, including respiratory distress syndrome (RDS), persistent pulmonary hypertension, and necrotizing enterocolitis.[8]

The comparison of platelet indices mean and standard deviation values of healthy and sick neonates with other studies was explained in Table 6. In both the studies, sick neonates are comparatively high. In this study, it was found that platelet count values was high in healthy neonates than sick neonates but in the study conducted by Choi KH *et al*.[9] in 1996, platelet count values was high in sick neonates than healthy neonates and it was not statistically significant in both studies. MPV, PDW, PCT were nearly same in both groups and it was not statistical significance in both the studies.

Table 6: Comparison of healthy and sick neonates with other studies

Parameters	Present study (140) SYSMEX × s1000*i*		Choi KH *et al*.[37] (176) ABOTT CELL DYN 1600	
	Healthy 33 (23.6%)	Sick 107 (76.4%)	Healthy 70 (39.8%)	Sick 106 (60.2%)
PC	211.96 ± 66.9	200.75 ± 79.25	280 ± 105	301 ± 1.36
MPV	10.96 ± 0.81	10.70 ± 0.74	6.67 ± 1.36	6.88 ± 1.41
PDW	12.30 ± 1.80	12.13 ± 1.72	18.17 ± 0.97	18.37 ± 1.42
PCT	0.22 ± 0.06	0.21 ± 0.08	0.18 ± 0.06	0.20 ± 0.09

The comparison of platelet parameters mean and standard deviation values of healthy and sick neonates in relation to their full term was explained in Table 7. In both the studies, sick neonates are comparatively high. In this study, it was found that platelet count values was high in full term healthy neonates than sick neonates but in the study conducted by Choi KH *et al*.[9] in 1996, platelet count values was high in full term sick neonates than healthy neonates and it was not statistically significant in both studies. MPV, PDW, PCT were nearly same in both groups and it was not statistical significance in both the studies.

Table 7: Comparison of healthy full term and sick full term neonates with other studies

Parameters	Present study (140) SYSMEX × s1000*i*		Choi KH *et al*.[37] (176) ABOTT CELL DYN 1600	
	Full term 115		Full term 150	
	Healthy 22 (19.1%)	Sick 93 (80.9%)	Healthy 54 (36%)	Sick 96 (64%)
PC	221.77 ± 65.59	201.50 ± 80.2	277 ± 61	308 ± 139
MPV	10.87 ± 0.77	10.7 ± 0.74	6.64 ± 0.64	6.90 ± 1.47
PDW	12.14 ± 1.97	12.1 ± 1.73	18.20 ± 0.97	18.44 ± 1.45
PCT	0.23 ± 0.06	0.21 ± 0.08	0.18 ± 0.04	0.21 ± 0.10

The comparison of platelet parameters, mean and standard deviation values of healthy and sick neonates in relation to their preterm was explained in Table 8. In both the studies, sick neonates are comparatively high. In this study, it was found that platelet count values was high in preterm sick neonates than healthy neonates but in the study conducted by Choi KH *et al*.,[9] platelet count values was high in preterm healthy neonates than sick neonates and it was not statistically significant in both studies. MPV, PDW, PCT were nearly same in both groups and it was not statistical significance in both the studies.

Table 8: Comparison of healthy preterm and sick preterm neonates

Parameters	Present study (140) SYSMEX × s 1000*i*		Choi KH *et al*.[37] (176) ABOTT CELL DYN 1600	
	Preterm 25		Preterm 26	
	Healthy 11 (44%)	Sick 14 (56%)	Healthy 16 (61.5%)	Sick 10 (38.5%)
PC	192.36 ± 68.21	195.78 ± 75.16	301 ± 223	233 ± 58
MPV	11.05 ± 0.9	10.72 ± 0.75	6.86 ± 0.78	6.64 ± 0.62
PDW	12.61 ± 1.45	12.35 ± 1.71	17.74 ± 0.86	17.70 ± 0.86
PCT	0.21 ± 0.07	0.21 ± 0.08	0.20 ± 0.12	0.15 ± 0.04

The comparison of platelet parameters, mean and standard deviation values of neonates with birth asphyxia with other studies was explained in Table 9. In this study, birth asphyxia cases were more in relation to other disease. But, there was no statistical significance in platelet indices values irrespective of their gender and term and it was correlating with the studies conducted by Bellet N *et al*.[10] and Choi KH *et al*.

Table 9: Comparison of platelet indices values of neonates with birth asphyxia:

Birth asphyxia	Present study 69 (64.5%)	Choi KH *et al*.[37] 8 (7.54%)	Bellet N *et al*.[38] 24 (70.6%)
PC	209.33 ± 80.61	241 ± 104	208.11 ± 26.11
MPV	10.70 ± 0.73	6.55 ± 0.51	8.54 ± 0.22
PDW	11.92 ± 1.51	17.84 ± 2.52	–
PCT	0.22 ± 0.08	0.15 ± 0.06	–

The comparison of platelet parameters, mean and standard deviation values of neonates with meconium aspiration syndrome with other studies was explained in Table 10.

Table 10: Comparison of platelet indices values of neonates with meconium aspiration syndrome

Meconium aspiration syndrome	Present study 31 (28.9%)	Choi KH *et al*.[37] 10 (9.43%)
PC	181.19 ± 77.22	234 ± 136
MPV	10.74 ± 0.83	6.62 ± 1.06
PDW	12.62 ± 2.15	18.48 ± 0.77
PCT	0.19 ± 0.07	0.16 ± 0.09

Meconium aspiration syndrome was the second common disease encountered in this study and it was compared with study conducted by Choi KH *et al*.[9] showed no statistical difference in platelet indices values in both the studies in relation to their gender and term. The comparison of platelet parameters, mean and standard deviation values of neonates with sepsis and other studies was explained in Table 11. In this study, their was no statistical difference in platelet indices values in neonates with sepsis in relation to their gender, term and gestational age and it was correlating with the studies conducted by Choi KH *et al*.[9]

Table 11: Comparison of platelet indices values of neonates with sepsis

Meconium aspiration syndrome	Present study 5 (4.67%)	Choi KH *et al*.[37] 6 (0.56%)
PC	210.4 ± 81.45	292 ± 115
MPV	10.48 ± 0.58	6.40 ± 0.60
PDW	11.92 ± 1.23	17.32 ± 0.46
PCT	0.22 ± 0.08	0.15 ± 0.03

The comparison of platelet parameters, mean and standard deviation values of neonates with hyperbilirubinemia and other studies was explained in Table 12. In our study, the total number of cases with hyperbilirubinemia was less compared to that study done by Choi KH *et al*.[9] But, there was no statistical significant of platelet indices values in both studies in neonates with hyperbilirubinemia in relation to their gender, term and gestational age.

Table 12: Comparison of platelet indices values of neonates with hyperbilirubinemia

Hyperbilirubinemia	Present study 2 (1.86%)	Choi KH *et al*.[37] 36 (33.9%)
PC	184 ± 22.62	341 ± 133
MPV	10. ± 0.14	7.08 ± 1.90
PDW	12.2 ± 1.55	18.51 ± 1.30
PCT	0.19 ± 0.02	0.22 ± 0.07

Conclusion

These data indicate that platelet indices of neonates showed some significance in values related to gender but not with term of the neonates. But there was no significance between healthy neonates and sick neonates. Neonates with birth asphyxia and meconium aspiration syndrome was seen predominantly. Further studies will be needed in clinical application of platelet indices in neonates.

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