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Original Research Article

A Retrospective Investigation to Study the Relationship between White Blood Cell Count (WBC), Which is Known Inflammatory Marker and Platelet Count (PLT) and its Parameters

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Abstract

Aim: The aim of this study was to investigate the relationship between white blood cell count (WBC), which is known inflammatory marker and platelet count (PLT) and its parameters including mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT) and platelet- large cell ratio (P-LCR) in all clinical setting of leukocytosis in children.

Methods: We performed a retrospective study on the children (2-18 years of age) coming to our laboratory Netaji Subhas Medical College & Hospital, Bihta, Patna, Bihar for the period of 9 months. Total 300 children were evaluated. Out of these,150 children with elevated WBC count (>4000/mm 3) were called as Group 1 and 150 subjects with normal WBC counts and the platelet parameters were included in the study as a control group (Group 2).

Results: There were 90 males and 70 were females in the present study. Totally (including Group 1 and Group 2 children), 300 complete blood counts were analysed. The mean age of subjects was 11.88 ± 6.647 years for group 1 and 11.37 ± 6.505 years for group 2. There were not statistically significant differences between two groups with respect to age. The result depicts the best cut-off points, sensitivity and specificity of PLT and platelet indices. The sensitivity was highest for platelets at 96.67 and lowest for MPV 32.97 while as specificity was highest for WBC at 94.4 for MPV was 92.22 and lowest for PLT 30.77.

Conclusion: This study showed that platelet count and platelet distribution width values were significantly high in simple infectious and inflammatory conditions in children but there is no correlation with platetcrit, MPV and P-LCR values. The correlation is low as the sample size is less. There are controversial results with regard to platelet parameters in many studies done on both adult and pediatric population.

Keywords: Platelets, Leucocytosis, Platelet Indices, Children.

Introduction

Fever, often known as pyrexia, is a condition in which the normal body temperature is elevated above homeostasis. [1] Infectious, inflammatory, neoplastic, and other causes of fever can be categorized into four categories. Fever in the paediatric population is usually grouped into 4 categories: fever in the neonate, fever with localizing signs, fever without source (FWS) and fever of unknown origin (FUO). Fever is a condition in which the body temperature increases over normal levels, and according to Saladin's great scientific text, it is a good condition as long as it does not last or reach 44°C to 46°C, at which point it might be fatal or cause irreversible brain damage. [1,2]

Platelets (PLTs) are cytoplasmic fragments of bone marrow megakaryocytes with a diameter of 3-5 μm and a volume of 4.5-11fL. Life span of platelets is 7-10 days. They are discoid cells with no nucleus and show variability in terms of volume, intensity, age and metabolic functions. They play an important role not only in hemostasis, but also in angiogenesis, inflammation, allergic reactions and repair and renewal of tissues and contain mediators which lead to strong inflammatory response. [3,4] The platelet volume is specified during formation of platelets from megakaryocytes in the bone marrow. No maturation occurs in the platelets in the circulation. Therefore, factors stimulating the bone marrow including inflammation and infection may lead to changes in the platelet volume and number. [5,6]

Fever is a symptom of an underlying illness. In febrile individuals, tachycardia, irritability, chills, and cutis marmorata are common. Fever suppression boosts viral and bacterial agent reproduction and supports the body's acute phase reaction, according to several studies. [6] However, no previous research in the paediatric age range have looked at changes in platelet parameters in relation to the duration of fever (of infectious origin). One type of blood cell is platelets. However, because they lack a nucleus, some authors do not consider them to be cells. Platelets, however, behave similarly to cells in many respects. Platelets have an important role in haemostasis, according to researchers. Platelets also shield some tumour cells from the immune system. Platelets are also implicated in the immune system response to host defences at the same time. [7] Atherothrombosis, inflammatory lung disease, inflammatory bowel illness, and inflammatory skin disease have all been linked to platelet-leukocyte interactions. Phospholipid vesicles are found in platelets and are released into the environment after viral or bacterial interaction. Infectious diseases can therefore impact platelet parameters. Platelet counts in the typical range are 150.000-450.000 per microliter.

Platelet indices are biomarkers of platelet activation. They may be used in detection of inflammation, in detection of the prognosis and active periods of diseases and in specifying the efficiency of treatment. [8] Mean platelet volume (MPV) is a simple measure of platelet size that can detect abnormal function and activity of platelets. Increased MPV means more platelet activity and excessive secretion of mediators. [9,10] The average MPV is 7.2-11.7 fl. [11] MPV is inversely related to platelet counts. [12] Platelet distribution width (PDW) directly measures variability in platelet size, changes with platelet activation, and reflects the heterogeneity in platelet morphology. It is an indicator of platelet anisocytosis. [12] The reference intervals range from 8.3-56.6% [5].Under physiological conditions, there is a direct relationship between MPV and PDW; both usually change in the same direction. [13] Plateletcrit (PCT) is the volume occupied

by platelets in the blood as a percentage and the normal range is 0.22-0.24%. [10] Under physiological conditions, the amount of platelets in the blood is maintained in an equilibrium state by regeneration and elimination. PCT parallels the platelet count. [12]

The aim of this study was to investigate the relationship between white blood cell count(WBC), which is known inflammatory marker and platelet count (PLT) and its parameters including mean platelet volume(MPV), platelet distribution width(PDW), plateletcrit (PCT) and platelet- large cell ratio (P-LCR) in all clinical setting of leukocytosis in children.

Materials and Methods

performed a retrospective study on the children (2-18 years of age) coming to our laboratory Netaji Subhas Medical College & Hospital, Bihta, Patna, Bihar for the period of 9 months. Total 300 children were evaluated.

Out of these,150 children with elevated WBC count (>4000/mm 3) were called as Group 1 and 150 subjects with normal WBC counts and the platelet parameters were included in the study as a control group (Group 2).

Children under 2 years of age are excluded as platelet count up to 6 lakh/mm3 is normal for that age.

Complete blood count (CBC) values were recorded which were obtained by SYSMEX automated hematology analyzer using VCS (volume- conductivity-light scatter) technology. The analyses were carried out following daily quality control. Children with haematological malignancies, known platelet disorders, haemolytic anaemia and children with a history of recent blood transfusions or splenectomy were excluded from the study. Children with WBC count > 50000/mm 3 (leukemias) are excluded from the study. Statistical analyses were performed by statistical software program SPSS for Windows version 20.0 (SPSS). Results were given as mean±standard deviation (SD) and minimum and maximum (min-max) values. The correlation between WBC and platelet parameters was assessed using two independent tests. Values <0.05 was considered as significant.

Results

Table 1: Sex distribution of patients

Gender	N	%
Male	90	60
Female	70	40

There were 90 males and 70 were females in the present study.

Table 2: General characteristics of the study subjects

Variables	Group	N	Mean	Std. Deviation	Sig. (2-tailed) 95%	Confidence Interval of the Difference	
						Lower	Upper
WBC count	1	150	14.6581	5.16234	0.000	6.12538	7.75496
	2	150	7.7179	2.23967	0.000	6.06481	7.81554
Platelet count	1	150	3.3525	1.02211	0.003	0.10291	0.48220
	2	150	3.0599	0.77285	0.003	0.09745	0.48765
PCT	1	150	0.5560	3.01852	0.173	-0.13125	0.72781
	2	150	0.2577	0.05316	0.219	-0.17918	0.77574
PDW	1	150	10.3679	1.76365	0.001	-1.99614	-0.47760
	2	150	11.6048	4.54944	0.001	-1.94225	-0.53149
MPV	1	150	9.7308	2.61469	0.557	-0.28146	0.52174

	2	150	9.6106	0.96080	0.587	-0.31498	0.55526
PLCR	1	150	21.1167	6.95695	0.069	-2.80301	0.10336
	2	150	22.4665	6.75486	0.069	-2.80763	0.10798

Totally (including Group 1 and Group 2 children), 300 complete blood counts were analysed. The mean age of subjects was 11.88 ± 6.647 years for group 1 and 11.37 ± 6.505 years for group 2. There were not statistically significant differences between two groups with respect to age.

Table 3: Sensitivity, specificity and accuracy of PLT and platelet indices

Variables	Cut-off point	Sensitivity	Specificity	AUC 95%	CI	SE	P value
PLT	>252000	96.67	30.77	0.626	0.551-0.697	0.0419	<0.001
MPV	≤7.7	32.97	92.22	0.649	0.575-0.719	0.0409	0.972
PDW	≤8.9	37.36	83.33	0.622	0.547-0.693	0.0417	0.564
WBC	>10400	97.8	94.4	0.995	0.971-1.00	0.00251	<0.001
PCT	≤0.17	94.74	78.05	0.888	0.100-0.150	0.0101	0.944

The result depicts the best cut-off points, sensitivity and specificity of PLT and platelet indices. The sensitivity was highest for platelets at 96.67 and lowest for MPV 32.97 while as specificity was highest for WBC at 94.4 for MPV was 92.22 and lowest for PLT 30.77.

Discussion

Children with fever and high CRP had a significantly higher platelet count and a significant positive connection with CRP, according to our findings. The findings support those of Pillai et al who discovered that children with fever and high CRP had a considerably higher platelet count and a significant positive connection with CRP (p-value=0.003). [14]

In our study, among all the platelet indices, platelet count and PDW values were significantly correlated ($p<0.05$) with increased WBC count in group 1 individuals when compared to group 2 with normal WBC count. Other parameters like PCT, MPV and P-LCR values were not correlated significantly ($p>0.05$). In a similar study by Ozturk N et al. [15] they found that the PLT counts and PCT values significantly increased in patients with leucocytosis when compared with the control group with normal WBC count. In addition, they have found that MPV and PDW values were not significantly different in both groups. Some research found greater MPV values, while others found lower MPV values. Tekin et al found that the MPV's sensitivity and specificity were 81.4 percent and 86.3 percent, respectively, while utilising a cut-off value of 8.2 fl. [16] Various investigations on MPV in patients with infectious and inflammatory disorders produced inconsistent results. MPV had a substantial negative connection with CRP in our study with a significant cut off value of MPV is ≤7.7 fl. Mean platelet volume (MPV) has been evaluated in many conditions in the literature. However, studies have frequently shown controversial results. Tuncel et al. [17] compared the MPV values between patients who had asthma attack and healthy individuals and found no significant difference between the two groups.

Patients with lower PLT count and PCT ($p=0.001$ and 0.001, respectively), increased MPV and PDW ($p=0.014$ and 0.004, respectively) had a significantly higher risk of mortality than those with normal platelet indices, according to Samuel et al. [18] According to Makwana et al, increased MPV, PDW, and PCT were related with a longer hospital stay and a

longer fluid therapy requirement. [19] According to Srinivasa et al, MPV and PDW levels were greater in patients with culture-proven sepsis, particularly with gram-positive organisms. PDW had a negative connection with CRP in our study. [20] PDW levels were considerably greater in difficult acute appendicitis compared to non-complicated acute appendicitis in research by Boshnak et al. In a case control study, Zainab et al discovered that the MPV/PCT, PDW/platelet count, and MPV/platelet count in the first sample after admission were accurate predictors of mortality, predicting 65 percent to 67 percent of fatalities. [21,22]

In a study by Lee et al, the APN group had significantly greater WBC, ESR, CRP, and MPV levels than the lower UTI group. PDW, CRP, and platelet count were all positively linked with MPV. [23] CRP and MPV were found to be independent predictors of APN in multiple logistic regression studies. However, MPV had a lower area under the ROC curve than CRP. The results suggest that MPV can be an inflammatory marker in UTI, but the predictive value of MPV was not superior to CRP in the diagnosis of APN. Kefeli et al discovered that MPV could be a helpful parameter to serve as an indicator for AP and a predictive factor for AP. [24] According to the findings of Icli et al, patients with infective endocarditis have enhanced platelet activation, and infective endocarditis therapy reduces platelet activation by lowering MPV. [25]

The study done by Elmeneim et al [26] on critically ill children showed increase in MPV in sepsis. This observation is similar to studies done by Dastugue et al [27] who reported rise in MPV in patients with shock and also study by Lelei VDJ et al [28], showed higher MPV values in patients with sepsis, indicating that monitoring of MPV can help in risk stratification of critically ill children. Sriram SM et al [29] reported that PCT, MPV, PDW and platelet count showed statistically significant relation in children with sepsis when compared to controls. These findings show that a linkage of PLT indices is present not only in simple but also in severe infections, and these indices can thus be used for daily clinical practice. [30]

Conclusion

This study showed that platelet count and platelet distribution width values were significantly high in simple infectious and inflammatory conditions in children but there is no correlation with platetcrit, MPV and P-LCR values. The correlation is low as the sample size is less. There are controversial results with regard to platelet parameters in many studies done on both adult and pediatric population. And very few similar studies were done on children. Hence, we need more such studies to come up on role of platelet indices on various clinical conditions in children for the employment of these indices in routine clinical practice in adjunct to other inflammatory markers.

Ethical Approval: Not required as secondary data is used in the current Study.

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