Original Research Article

A prospective study of platelet indices and their interpretation in thrombocytopenia in a tertiary care hospital

Aditi Bhattacharyya[1], Biswanath Paul[2], Soumya Kundu[3],Tarak Nath Saha[4*]

[1]Associate Professor, Department of Pathology, Calcutta National Medical College, West Bengal, India
[2]Assistant Professor, Department of Pathology, Midnapore Medical College, Midnapore, West Bengal, India
[3]Assistant Professor, Department of Pathology, Midnapore Medical College, Midnapore, West Bengal, India
[4]Associate Professor, Department of Pathology, Midnapore Medical College, Midnapore, West Bengal, India

Received: 13-01-2021 / Revised: 19-03-2021 / Accepted: 06-04-2021

Abstract

Introduction: Thrombocytopenia is a significant finding in hospitalized patients who may be often missed if platelet parameters are not evaluated routinely. Platelet count below 150 x 10^9 /L defines Thrombocytopenia, but this does not reveal the underlying pathology. During the evaluation of these patients, it is essential to identify the etiology, whether it is due to hypoproduction or peripheral destruction, which will have an impact on the proper management of the patients. For a long time, Bone marrow aspiration remained the gold standard method for evaluating the cause of Thrombocytopenia. The objective of the present study was to investigate the role of platelet indices in the differential diagnosis of thrombocytopenia.**Materials and Methods:** An observational cross-sectional study was undertaken for a period of one year from January 2019 to December 2019 in the Department of Pathology, Midnapore Medical College. All the blood samples of patients which were received in K3-EDTA anti-coagulated vacutainers in the laboratory were processed within one hour of collection using the 5-part automated hematology analyzer. (Pentra ES 60, Horiba Medical) From the analyzer generated reports, platelet count and platelet parameters i.e., mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR), and plateletcrit (PCT) were recorded, and platelet count was reassessed by peripheral blood smear examination on Leishman stained slides in all the cases. We included 155 patients of age more than one year with Thrombocytopenia (platelet count < 150 x 10^9 / L). The Control group included 71 persons who had all the haemogram parameters within normal limits. **Results:** A total of 155 patients with Thrombocytopenia after informed consent were included in the study. There were 65 % males and 35 % females in this study. Table I shows the age-sex-wise distribution of the cases with Thrombocytopenia. Our age group ranged from 1 - 80 years, with more than 54 % of the cases falling in the age group of 21 - 40 years. On analyzing the results only PCT showed a direct relationship with the decreased platelet count which was statistically significant (P-value < 0.05).**Conclusion:** Plateletcrit can help assess both quantitative as well as qualitative platelet disorders and there is direct relation between PCT and platelet count. Other parameters like PDW, P-LCR and MPV along with PCT can be used to interpret the mechanism behind the low platelet count, where high values of indices indicate increased breakdown of platelets in the bloodstream and low values are possibly due to impaired production due to primary or secondary bone marrow disease.

Keywords: Thrombocytopenia, MPV, PDW, PCT.

Introduction

Thrombocytopenia is a significant finding in hospitalized patients, which may be often missed if platelet parameters are not evaluated routinely[1].Platelet count below 150 x 10^9/L define Thrombocytopenia,but this does not reveal the underlying pathology. During the evaluation of these patients, it is essential to identify the etiology, whether it is due to hypoproduction or hyper destruction, which will have an impact on the proper management of the patients. For a long time, Bone marrow aspiration remained the gold standard method for evaluating the cause of Thrombocytopenia[2]. But this procedure is invasive, time-consuming as well as carry an overt risk of bleeding diathesis in critical thrombocytopenia cases. Serology (For infectious diseases),Platelet-associated Immunoglobulin G (PAIgG),and Molecular markers forDisseminated Intravascular coagulation (DIC) are used in evaluating thrombocytopenic patients, which are relatively costly[3].Previously, platelet count was the only vital information available about this small blood element. But recently, with the availability of Automated Blood Cell Analyzers, new indices related to platelet count are also being estimated[4].The most important parameters among them are plateletcrit (PCT), mean platelet volume (MPV) and platelet distribution width (PDW). Platelet activation leads to changes in platelet shape with increase in platelet size leading to an increase in MPV and PDW. Determinations of platelet size are traditionally made by microscopic measurements of platelet diameters, a method which is not readily available in routine daily practice[5]. The automated cell counter, however, provides an MPV on each whole blood sample that is processed, which makes possible the study of platelet size in a great variety of clinical conditions. In recent years studies have come up to explore the utility of these parameters in routine clinical practice[6].Platelet indices can have a significant prognostic role as early evaluation of Thrombocytopenia can help reduce morbidity and mortality of patients with low platelet count[7].This study aims to find the usefulness of these platelet indices in the initial evaluation, as their role is still not clear in patients with Thrombocytopenia.

**Correspondence*
Dr. Tarak Nath Saha
Associate Professor, Department of Pathology, Midnapore Medical College, Midnapore, West Bengal, India.
E-mail:drtaraknathsaha@gmail.com

Materials and Methods

An observational cross-sectional study was undertaken for a period of one year from January 2019 to December 2019 in the Department of Pathology, Midnapore Medical College. All the blood samples of patients which were received in K3-EDTA anti-coagulated vacutainers in the laboratory were processed within one hour of collection using the 5-part automated hematology analyser. (Pentra ES 60, Horiba Medical) From the analyser generated reports, platelet count and platelet parameters i.e. mean platelet volume (MPV), platelet distribution width (PDW), platelet large cell ratio (P-LCR) and plateletcrit (PCT) were recorded and platelet count was reassessed by peripheral blood smear examination on Leishman stained slides in all the cases. We included 155 patients of age more than 1 year with Thrombocytopenia (platelet count < 150 x 10^9 / L). Control group included 71 persons who had all the haemogram parameters within normal limits. Informed consent was obtained for all cases included in this study.

Exclusion Criteria

- Patients of age < 1 year (infants) – to avoid age related changes in platelet indices.
- Patients with diagnosed myelodysplastic syndrome. (MDS)
- Patients with autoimmune disorders such as systemic lupus erythematosus (SLE), Type 1 diabetes mellitus (DM), vitiligo, juvenile rheumatoid arthritis .
- Patients on anti-platelet drugs and drugs causing Thrombo cytopenia.

Platelet parameters were then assessed in both the groups and compared with those of the control group.

Statistical Analysis

The data was tabulated and analyzed using the Statistical Package for the Social Sciences (SPSS) software 23.0 for Windows 10. Statistical mean and standard deviation were calculated for the respective parameters in the different groups. Multiple comparisons and associations were assessed using an analysis of variance (ANOVA) and Bonferroni's test was used as a post hoc test between different categories. A P-value of less than 0.05 only was considered as statistically significant.

Results

A total of 155 patients with Thrombocytopenia after informed consent were included in the study. There were 65 % males and 35 % were females in this study. Table I shows the age-sex wise distribution of the cases with Thrombocytopenia. Our age group ranged from 1 - 80 years, with more than 54 % of the cases falling in the age group of 21 - 40 years.

Comparison of the platelet indices with the severity of Thrombocytopenia was also assessed. (Table II) They were categorized into 3 categories: mild thrombocytopenia with platelet count ≥ 100 to < 150 x 10^9 / L, moderate thrombocytopenia with platelet count > 50 x 10^9 / L and < 100 x 10^9 / L and severe thrombocytopenia with platelet count ≤ 50 x 10^9 / L. Our study showed a significant difference only in one of the platelet parameters i.e. plateletcrit (P < 0.001), while the rest of the parameters showed no significant difference.

Table 1: Age and Sex Distribution of cases of Thrombocytopenia

S.No	Age group (in years)	Male	Female	Total No	%
1	01-10	8	6	14	9.03
2	11-20	15	13	28	18.06
3	21-30	32	14	46	29.68
4	31-40	28	11	39	25.16
5	41-50	9	4	13	8.39
6	51-60	5	2	7	4.52
7	61-70	3	3	6	3.87
8	71-80	1	1	2	1.29
9	Total	101 (65.16%)	54 (34.84%)	155	100

Table 2: Relationship of platelet Indices with Severity of Thrombocytopenia

Platelet Count	Cases	PDW (fL) Mean ± SD	MPV (fL) Mean ± SD	P-LCR Mean ± SD	PCT (%) Mean ± SD
≤50x10^9/L	25	18.06 ± 3.29	13.21 ± 1.07	49.36 ± 7.03	0.03 ± 0.01
>50-≤100 x 10^9/L	50	18.71 ± 3.10	13.48 ± 1.18	52.37 ± 9.32	0.06 ± 0.02
≥100-≤150x10^9/L	80	19.02 ± 3.32	13.55 ± 1.18	52.60 ± 9.18	0.08 ± 0.03
P-value (between groups)		0.428	0.460	0.269	< 0.001*

PDW – Platelet Distribution Width, MPV – Mean Platelet Value,P - LCR – Platelet Large Cell Ratio, PCT – Plateletcrit.The mean difference is significant at the level 0.05 level

Table 3: Platelet Count and Platelet Parameters According to Each Group

Group	Cases	Platelet (x 10^9 / L) (Mean ± SD)	PDW (fL) (Mean ± SD)	MPV (fL) (Mean ±SD)	P-LCR (%) (Mean ± SD)	PCT (%) (Mean ± SD)
A - Accelerated destruction	102	103.7 ± 23.6	19.37 ± 3.04	13.66 ± 1.15	53.64 ± 8.98	0.08 ± 0.02
B - Impaired production	53	71.5 ± 32.3	17.60 ± 3.34	13.11 ± 1.10	48.85 ± 8.03	0.03 ± 0.01
Control	71	249.7 ± 77.5	16.01 ± 4.40	12.21 ± 1.75	41.85 ± 13.63	0.25 ± 0.09

Table 4: Statistical Comparison of Platelet Parameters within Groups

Platelet Parameters	Group A vs. Control			Group B vs. Control			Group A vs. Group B		
	Mean	SD	P-Value	Mean	SD	P-Value	Mean	SD	P-Value
PDW	3.3623	0.555	p<0.001	1.5925	0.65	0.046	1.76 98	0.608	P = 0.012*
MPV	1.4485	0.210	p<0.001	0.9057	0.24	0.001	0.542	0.230	P = 0.05 9
P-LCR	11.786	1.620	p<0.001	7.000	1.90	0.001	4.785	1.775	P = 0.023*
PCT	0.1643	0.008	p<0.001	0.220	0.01	0.001	0.056	0.009	P < 0.001*

Patients with Thrombocytopenia were divided into 2 groups according to the mechanism causing low platelet count i.e. group A included those with hyper destructive causes of low platelet count and group B included causes leading to impaired production of platelets. Group A included 102 patients who were diagnosed as either of the following: dengue (28), burns (5), pregnancy (13),

malaria (16), typhoid (8), disseminated intravascular coagulation (4), sepsis (6), viral infections (12), immune thrombocytopenic purpura (3), or renal diseases (7). Group B included 53 patients who were diagnosed as either of the following: tuberculosis (11), chicken pox (3), deep vein thrombosis (2), chikungunya(7), megaloblasticanaemia (10), Aplastic Anemia (8), Acute leukemia (8), or cirrhosis (4). Group A cases 65.8 % as compared to 34.2 % cases in Group B. Table 3 and 4 show comparison and statistical analyses between the mean platelet parameters within the two groups of Thrombocytopenia and also the controls. It shows a significant difference i.e., P value < 0.05 in PDW, P-LCR and highly significant difference i.e., P < 0.001 in mean PCT values of the three categories. Mean MPV shows slight difference when Thrombocytopenia is compared with control but there is no difference between the 2 mechanisms of low platelet count (P = 0.05).

Discussion

Thrombocytopenia is one of the common findings in many disease conditions. The major pathogenesis behind this is either due to decreased or impaired bone marrow production, peripheral accelerated destruction or due to increased splenic sequestration. Clinically, it is difficult to ascertain the reason behind the decrease in platelet count. Bone marrow studies, reticulated platelets and platelet-associated IgG have been done in the past to evaluate the reason causing Thrombocytopenia, but these are costly, invasive and not easily available procedures[8,9]. Recently, many studies have taken the help of various platelet indices to assess the cause of Thrombocytopenia. Platelet indices are easily available as most of the automated haematologyanalysers calculate these values. We studied four platelet parameters i.e., MPV, PDW, P-LCR and PCT in cases of Thrombocytopenia in order to interpret their importance, if any, behind the mechanism of low platelet count and also compared these values with those of the controls.

Our study included 155 patients of Thrombocytopenia, who were predominantly male, which was similar in many studies. Correlation of severity of Thrombocytopenia was studied with the changes in the platelet count and the platelet parameters. It was found that although as the platelet count decreases there was reduction in the mean values of all the platelet indices, only PCT showed a direct relationship with the platelet count with P-value < 0.05. The mean PCT in cases of mild, moderate and severe Thrombocytopenia was 0.08 %, 0.06 % and 0.03 % respectively. Chandrashekhar V in 2013 also justified the importance of PCT in detecting quantitative platelet disorders, where PCT can help determine the need for transfusion in cases of low platelet count[10]. This is important as all the thrombocytopenia cases don't require platelet transfusion. Also mean MPV, Mean PDW and mean P-LCR were least in cases with severe Thrombocytopenia and highest in mild Thrombocytopenia, but a significant difference was not observed.On reviewing the literature, many studies have shown higher values of these parameters in hyper destructive group as compared to hypo productive group, but their significance has not been verified. As a result the cut off value has not been set by which one can place a case in one of the two categories. So further studies on platelet indices and with other markers like immature platelet fraction should be done so as to have a criterion for classifying Thrombocytopenia with the help of these easily available markers[11].

Conclusion

Plateletcrit can help assess both quantitative as well as qualitative platelet disorders and there is direct relation between PCT and platelet count. Other parameters like PDW, PLCR and MPV along with PCT can be used to interpret the mechanism behind the low platelet count, where high values of indices indicate increased breakdown of platelets in the bloodstream and low values are possibly due to impaired production due to primary or secondary bone marrow disease. These parameters need to be studied more as their significance, if recorded, can prove to be very useful in establishing causes of Thrombocytopenia and will also reduce the need for the costly and invasive procedures, at least in routine cases.

Abreviations

EDTA, ethylene diamine tetra-acetic acid; MPV, mean platelet volume; PCT, plateletcrit; PDW, platelet size distribution width; P-LCR, platelet large cell ratio

References

1. Strau BG, Vollert C, Von Stackelberg A, Weimann A, Gaedicke G, Schulze H. Immature platelet count: A simple parameter for distinguishing Thrombocytopenia in pediatric acute lymphocytic leukemia from immune Thrombocytopenia. Pediatr Blood Cancer. 2011; 57:641-7.
2. Kaito K, Otsubo H, Usui N, Yoshida M, Tanno J, Kurihara E, et al. Platelet size deviation width, platelet large cell ratio, and mean platelet volume have sufficient sensitivity and specificity in the diagnosis of immune Thrombocytopenia. Br J Haematol 2005; 128:698-702.
3. Park Y, SchoeneN, Harris W. Mean platelet volume as an indicator of platelet activation: methodological issues. Platelets. 2002;13:301–6.
4. Giovanetti TV, do Nascimento AJ, de Paula JP. Platelet indices: laboratory and clinical applications. Rev Bras Hematol E Hemoter. 2011; 33:164–5.
5. Borkataky S, Jain R, Gupta R, Singh S, Krishan G, Gupta K et al. Role of platelet volume indices in the differential diagnosis of Thrombocytopenia: a simple and inexpensive method. Hematology. 2009;14:182–6.
6. Amar S, Sanjay N. Role of platelet parameters in diagnosing various clinical conditions. Natl J Med Res. 2005;3:162-5.
7. Parashar Y, Kushwaha R, Kumar A, Kamal A, SinghUS, JainM et al. Haemostatic Profile in Patients of Myeloproliferative Neoplasms-A Tertiary Care Centre Experience.JCDR. 2016; 10:EC01-4.
8. Dastjerdi MS, Emami T, Najafian A, Amini M. Mean platelet volume measurement,EDTA or citrate.Hematology. 2006;11: 317-9.
9. Briggs C, Harrison P, Machin SJ. Continuing developments with the automated platelet count. Int J Lab Hematol. 2007; 29:77-91.
10. Chandrahsekar V.Plateletcrit as a Screening Tool for Detection of Platelet Quantitative Disorders. Journal of Hematology, North America, 2013:1.
11. Sewakdas KP, Ashish P,Sarika M, Megha P. Platelet Distribution Width (PDW) -A Rarely Studied Platelet Indice for Determining the Causes of Thrombocytopenia. Annals of International medical and Dental Research. 2016;2:193-7.

Conflict of Interest: Nil
Source of support:Nil