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DIAGNOSTIC ROLE OF PLATELET INDICES IN PATIENTS WITH THROMBOCYTOPENIA

Haematology

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ABSTRACT

Introduction: Thrombocytopenia is the most common cause of abnormal bleeding and can result from Hyper destruction of platelets, Hypoproduction of platelets and Abnormal platelet pooling. The aim of this study was to evaluate role of platelet indices (MPV, PDW, PCT) in diagnosing various causes of thrombocytopenia. **Methodology:** In this observational analytic study 600 study samples were divided into two groups: 300 cases diagnosed as thrombocytopenia (1.5 lakhs /microliter) and 300 healthy control. Cases of thrombocytopenia were further classified in 3 categories depending upon the predominant mechanism of thrombocytopenia. **Statistical Analysis:** Mean and SD of platelet count, mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT) in each group was calculated and compared among groups using unpaired T- test. **Results:** Out of 300 cases of Thrombocytopenia, Group A constituted 224 cases (75%) due to hyper destruction of platelets, Group B constituted 72 cases (24%) due to hypoproduction of platelets and Group C constituted 4 cases (1%) of Thrombocytopenia due to abnormal pooling of platelets. On comparing mean MPV and PDW values among groups, the MPV and PDW of hyper destructive thrombocytopenia was found to be higher than mean MPV and PDW of hypo productive thrombocytopenia as well as control group. The mean PCT of hyper destructive group was higher than that of hypo productive group. **Conclusion:** Combined interpretation of platelet count and platelet indices are of significant discriminating value in differentiating various causes of thrombocytopenia thus their standardized measures can significantly increase its utility in diagnosis and understanding mechanism of various clinical condition.

KEYWORDS

Thrombocytopenia, MPV, PDW

INTRODUCTION

Thrombocytopenia (TCP) is a fairly common condition with diverse disorders and varying etiology. It is the most common cause of abnormal bleeding. Thrombocytopenia may be defined as a subnormal number of platelets (below 150000/cumm) in circulating blood.[1]

TCP results mainly from three mechanism: A) Hyperdestruction of platelets: as in idiopathic/primary autoimmune (idiopathic thrombocytopenic purpura), Secondary (systemic lupus erythematosus, chronic lymphocytic leukemia, lymphoma), Infections (HIV, hepatitis B and C, malaria, dengue), Drug induced (alcohol, rifampicin, penicillins, sulphonamides, Heparin, quinine), Post-transfusion purpura and Disseminated intravascular hemolysis (DIC)[2,3].

B) Hypo-production of platelets: due to bone marrow suppression like aplastic anemia, megaloblastic anemia, leukemias, infiltration by malignancy, chemotherapy and irradiation.[1] or C) Abnormal pooling of the platelets within the body in splenomegaly and dilutional thrombocytopenia in massive blood transfusion.[2,3]

For the diagnosis of thrombocytopenia, platelet counts alone do not explain the underlying patho-mechanism, Identification of the underlying cause of thrombocytopenia is necessary to decide appropriate treatment so it is important to differentiate between hypo-productive and hyper-destructive thrombocytopenia.[3]

The modern hematology analyzers provide platelet parameters like MPV, PDW and PCT along with platelet count which are simple, non-invasive and reproducible methods available in most health care centers, courtesy; the modern hematology cell analyzers[4,5] Several studies have shown sufficient sensitivity and specificity of these parameters in the diagnosis of TCP and these can be considered as discriminating factor between TCP involving bone marrow(decreased platelet production/hypoproductive) and TCP cases where bone marrow is normal(peripheral destruction of platelets/ hyperdestructive).[4,5]

This study was undertaken to classify various clinical conditions causing thrombocytopenia according to etiology, correlate platelet count and platelet indices (MPV, PDW, PCT) among different categories based on their patho-mechanism and to evaluate the usefulness of these indices in diagnosing various causes of thrombocytopenia by assessing their variation in different clinical scenarios.

MATERIALS AND METHODS:

This is a hospital based observational analytic study carried out at hematology lab of a tertiary care hospital during the period of one year. The study was approved by the local ethical committee. Total 600 study cases were enrolled and divided into two groups.

The test group comprised of 300 patients diagnosed with thrombocytopenia (platelets <150000/micro liter). The second group comprised 300 normal healthy persons above 18 years of age which were undergoing a routine medical check-up or minor elective surgery and were having normal hemogram profile. Patients below 18 years of age and patients on anticoagulant therapy or other drugs which cause thrombocytopenia were excluded.

The EDTA whole blood samples of all the study cases were collected and processed within 6 hrs. on automated hematology analyzer and verified on peripheral blood smear. All the required quality control check were run as per standard guidelines.

In test group (thrombocytopenia), details including age, sex, detailed clinical history, examinations findings and all the investigation including hematological, radiological, biochemical and other as needed in each case to confirm the clinical diagnosis were retrieved from case sheet and were recorded. Cases of ITP and aplastic anemia were confirmed on bone marrow examination. Cases with sufficient clinicohaematological work up were included in the study. Platelets count and platelets parameters (MPV, PDW,PCT) were recorded in both test group and control group.

Thrombocytopenia cases were classified in 3 categories depending upon the predominant mechanism: Hyperdestruction of platelets, Hypoproduction of platelets and Abnormal pooling of the platelets which included cases with isolated splenomegaly without any associated pathology causing TCP.

Mean and SD of platelet count and all platelet indices(MPV, PDW, PCT) in each group were calculated and compared with control group and among other TCP group. Collected data was entered in Microsoft excel sheet and data was analyzed by using softwareStatistical Package for the Social Sciences (SPSS). Quantitative data were summarized in form of mean and S.D.

RESULTS:

In the present study, platelet count and platelet volume parameters were performed on 300 cases of thrombocytopenia of various

etiologies and 300 cases of healthy person taken as controls.

Out of 300 cases of TCP, commonest age group for TCP was between 18-30 years accounting for 173(57.6 %) cases. A slight male preponderance was seen in overall picture as well as in almost all age groups. 174 cases (58%) were male and 126 cases (42%) were female. Male to female ratio is 1.3:1.

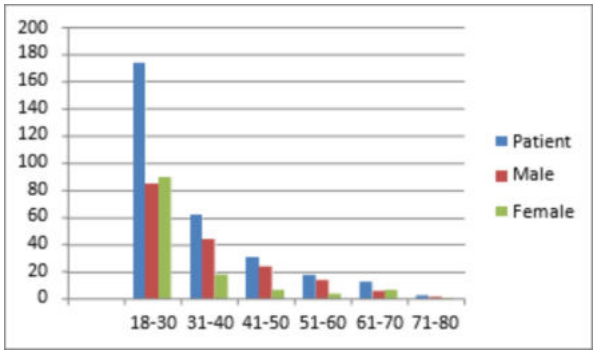

Chart 1: Age and Sex distribution among TCP cases

Out of 300 cases of TCP, Group A constituted 224 cases (75%) due to hyperdestruction of platelets, Group B constituted 72 cases (24%) due to hypoproduction of platelets and Group C constituted 4 cases (1%) due to abnormal pooling of platelets

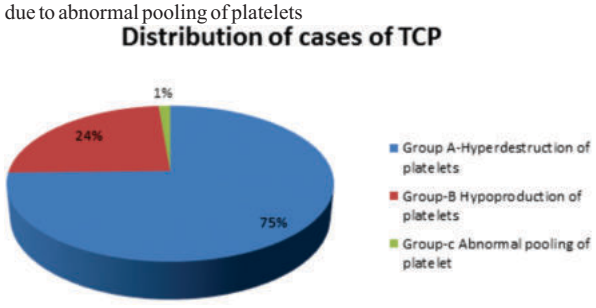

Chart 2: Percentage of distribution of cases of TCP according to predominant mechanism

Table 1: Mean Platelets, MPV, PDW and PCT of various categories of Hyperdestructive TCP (Group A)

	Category	No of cases	% of cases	Mean Plt 10^3 /cumm	SD	Mean MPV fl	Mean PDW %	Mean PCT %
1	Malaria	79	35.26	71.22	36.45	8.58	13.09	0.057
2	Dengue	59	26.33	70.28	35.22	9.11	14.30	0.062
3	Pregnancy	24	10.71	99.87	29.65	7.60	13.47	0.091
4	Bacterial infection	15	6.69	77.83	32.58	7.93	11.84	0.059
5	Viral infections	12	5.35	63.18	30.28	8.63	12.9	0.048
6	Liver disease	10	4.46	61.9	31.46	7.9	13.76	0.046
7	Renal disease	9	4.01	73.44	26.51	8.83	12.23	0.061
8	Sepsis	7	3.12	85.57	28.30	8.31	11.31	0.064
9	Cardiac disease	4	1.78	78.75	2.16	9.27	16.37	0.076
10	Blood transfusion	3	1.33	66.33	37.24	8.2	13.23	0.05
11	ITP	2	0.89	44.5	1.5	9.35	13.65	0.035
	Total	224	100					
	Mean			72.078	26.49	8.52	13.289	0.059

Group A (Hyperdestructive TCP) constituted maximum number of cases 224 (75%) due to hyperdestruction of platelets which was further subdivided into various categories based on clinical diagnosis like malaria, dengue, pregnancy, bacterial and viral infection, liver and renal disease, cardiac disease, sepsis, and ITP. Malaria constituted the greatest number of cases (n=79, 35.26%) followed by dengue in 59 cases (26.33%).

Mean platelet count for TCP with hyperdestruction of platelets was 72.07±26.49/cumm. Mean MPV, PDW and PCT was 8.52±0.83fl, 13.28±3.66%and 0.059±0.031% respectively.

Table 2: Mean Platelets, MPV, PDW and PCT Of various categories of Hypoproductive TCP (Group B)

	Categories	No of cases	% of cases	Mean Plt 10^3/cumm	SD	Mean MPV fl	Mean PDW %	Mean PCT %
1	Leukemia	32	44.44	67	28.28	7.95	10.09	0.052
2	Megaloblastic anaemia	21	29.16	65.33	33.13	8.85	12.60	0.051
3	Chemotherapy	7	9.72	48.71	32.76	8.02	9.3	0.040
4	Solid malignancy	7	9.72	89.71	27.03	7.4	13.41	0.066
5	Aplastic anaemia	5	6.94	65.33	32.06	7.3	11.76	0.041
	Total	72	100					
	Mean			67.21	30.65	7.90	11.43	0.050

Group B (Hypoproductive TCP) constituted 72 cases(24%) of TCP due to hypoproduction of platelets which included majority 32(44.44%) cases of leukemia followed by 21((29.16%)) cases of megaloblastic anaemia, 7 (9.72%)cases of solid malignancy, 7 (9.72%)cases of chemotherapy induced TCP and 5 (6.94%)cases of aplastic anaemia.

Mean platelet count of this group was 67.24±30.65/cumm. Mean MPV, PDW and PCT was 7.90±1.09 fl, 11.43±3.01%and 0.050±0.037% respectively

Table 3: Mean Platelets, MPV, PDW and PCT of cases of Abnormal pooling of platelet (Group C)

	Category	No of cases	% of cases	Mean Plt 10^3/cumm	SD	Mean MPV fl	Mean PDW %	Mean PCT %
	Splenomegaly	4	1.33	95.75	21.25	7.6	10.575	0.072

Group C (Abnormal pooling of platelets) included 4 (1.33%) cases with splenomegaly. Mean platelet count of this group was 95.75x10^3/cumm. Mean MPV,PDW and PCT was 7.6 ±0.23 fl., 10.57±2.63% and 0.072±0.014% respectively.

The control group constituted 300 normal healthy persons above 18 years having normal platelet count, red cell counts and white cell counts. Mean platelet count of all control subjects was 263.88±67.85/cumm. Mean MPV, PDW and PCT was 7.39±0.86fl., 11.77±02.49%and 0.192±0.04% respectively.

DISCUSSION:

Table 4: Comparison of Mean platelet count, MPV, PDW and PCT among different groups

	Group A	Group B	Group C	Control
Mean platelet count 10^3/cumm	72.08±26.49	67.21±30.65	95.75±21.25	263.88±67.85
Mean MPV (fl)	8.5±20.83	7.90±1.09	7.6±0.23	7.39±0.86
Mean PDW %	13.28±3.66	11.43±3.01	10.57±2.63	11.77±2.49
Mean PCT %	0.059±0.031	0.050±0.037	0.072±0.014	0.192±0.04

Table 5: Statistical significance MPV, PDW and PCT

MPV	
Group A Vs control	t=12.097 (p<0.0001)
Group B Vs control	t=4.722(p<0.0001)
Group A Vs Group B	t=3.582(p=0.0004)
PDW	
Group A Vs control	t=5.93 (p<0.0001)
Group B Vs control	t=-1.91(p=0.049)
Group A Vs Group B	t=-4.58(p=0.0001)
PCT	
Group A Vs control	t=-33.124 (p<0.0001)
Group B Vs control	t=-23.503(p<0.0001)
Group A Vs Group B	t=-2.033(p=0.0430)
(p<0.05 is significant)	

MPV:
On comparing mean MPV values among groups, the mean MPV of hyperdestructive TCP-Group A (8.52±0.83fl) was found to be higher than mean MPV of control group(7.39±0.86) as well as hypoproductive TCP-Group B(7.90±1.09fl), the P value of both are significant.

The mean MPV of hypoproductive TCP-group B (7.90±1.09 fl) was higher than mean MPV of control group(7.39±0.86), the P value of which is significant.

Negash et al[6], Baig et al[7], Parveen et al[11], Khaleel et al[3], Kuna et al[8], Khairkar et al[1], Reddy et al[9] and Numbenjapon et al[10] also found significantly higher value of MPV in hyperdestructive TCP group compared to hypoproductive TCP group. In hyper destructive thrombocytopenia, bone marrow compensates actively for the platelet loss and start releasing young larger platelets ("left shift") which tend to decrease in size during its 7-10 days life span. [10]

MPV is potentially useful marker indicating platelet activation and bone marrow response to platelet loss. In present study MPV was found to be significantly higher in hyperdestructive TCP compared to hypoproductive TCP as well as control group. Thus, MPV can be considered as a reliable marker to distinguish hyperdestructive and hypoproductive TCP. Although the difference is significant, clear cut off value of this parameter is difficult to establish as MPV is dependent on number of variables including the time of analysis after venipuncture, the anticoagulant used, the specimen storage, temperature, and the counter technologies.

PDW:
On comparing mean PDW values among groups, the mean PDW of hyperdestructive TCP group (group A) was 13.28±3.66% which was found to be higher than mean PDW of control group(11.77±02.49%) as well as hypoproductive TCP group-B(11.43±3.01%), the P value of both are significant.

The mean PDW of hypoproductive group (group B) was 11.43±3.01% which was lower than mean PDW of control group(11.77±02.49%), the P value of which is significant.

Negash et al[6], Baig et al[7], Parveen et al[11], Khaleel et al[3], Kuna et al[8], Khairkar et al[1] and Reddy et al[9] also found significantly higher value of PDW in hyperdestructive TCP group compared to hypoproductive TCP group.

A significant higher PDW in hyperdestructive TCP was reported in this study as compared to hypoproductive TCP group and control group, which is the result of heterogenic platelet population due to increase bone marrow production where platelet destruction is the predominant mechanism.

PCT:
PCT is the volume occupied by platelets in the blood as a percentage and calculated by the formula PCT = platelet count × MPV/10,000. The normal range for PCT is 0.22-0.24%. It is a useful parameter for detecting platelet quantitative abnormalities. As it represents the volume percent of platelets, it is affected by the severity of TCP of any cause. Typically, PCT parallels platelet count as seen in this study. The significant direct positive correlation of PCT was found with platelet count in both control group and TCP group. In the present study, mean PCT value also differs statistically between hyperdestructive and hypoproductive TCP..

TCP due to abnormal pooling of platelet (Group C) included only four cases in this study, therefore comparison of platelet count and platelet indices of group C with the other TCP group (Group A & B) and control group was not possible to assess statistically.

CONCLUSION:
Platelets play a significant role in normal hemostasis, thrombosis and in various bleeding disorders. Hence quantitative alterations in platelets (thrombocytopenia) cause great morbidity. The diagnosis and management of thrombocytopenia is a growing component in the practice of haematology.

Platelet volume parameters are widely available and generated at no extra cost as part of full blood count profile on automated haematology anayzer. The present study indicates that the platelet indices are of significant discriminating value in differentiating the various cause of TCP as they are differently altered depending upon the predominant mechanism and may provide a small initial window into the etiology of TCP. Further studies with large numbers of cases in each subgroup are needed to explore the role of these useful platelet indices in TCP and also to find the diagnostic role of these indices in various other diseases.

REFERENCES:

1. Khairkar PS, More S, Pandey A, Pandey M. Role of mean platelet volume (MPV) in diagnosing categories of thrombocytopenia. Indian J Pathol Oncol. 2016;3(4):606.
2. Reddy R S, Phansalkar M D, Ramalakshmi PVB, Mean Platelet Volume (MPV) in Thrombocytopenia ,J Cont Med A Dent May-August 2014 Volume 2 Issue 2,pg 45-50
3. Khaleel KJ, Ahmed AA, Alwash M, Anwar A. Platelet indices and their relations to platelet count in hypo-productive and hyper-destructive Thrombocytopenia. Karbala J Med. 2014;7(2):1952–8.
4. Khanna R, Nayak D M, Manohar C et al. "A retrospective evaluation of mean platelet volume as a discriminating factor in thrombocytopenia of hypoproductive and hyperdestructive aetiologies." Journal of Evolution of Medical and Dental Sciences 2013; Vol. 2, Issue 47, November 25; Page: 9059-9065.
5. Khairkar PS, Pandey A, More S, Pandey M. Platelet Distribution Width (PDW) - A Rarely Studied Platelet Indice for Determining the Causes of Thrombocytopenia. Ann Int Med Dent Res. 2016;2(4).
6. Negash M, Tsegaye A, G/Medhin A. Diagnostic predictive value of platelet indices for discriminating hypo productive versus immune thrombocytopenia purpura in patients attending a tertiary care teaching hospital in Addis Ababa, Ethiopia. BMC Hematology 2016; 16:18.
7. Baig MA. Platelet indices: evaluation of their diagnostic role in pediatric thrombocytopenias (one year study). Int J Res Med Sci 2015;3:2284-9.
8. Kuna N, Rao R, Maadhurika L, Spandana A, Salma SK, Chowdery G.P: Utility of Platelet Indices (Pi) In Thrombocytopenia - An Institutional Based Two Years Clincopathological Study; *IOSR Journal of Dental and Medical Sciences; Volume 18, Issue 1 Ver. 5 (January. 2019), Pg 21-26*
9. Reddy RS. Platelet Distribution Width (PDW) in Thrombocytopenia. 2015;(May):169–73.
10. Numbenjapon T, Mahapo N, Pornvipavee R, Sriswasdi C, Mongkonsritragoon W, Leelasiri A, et al. A prospective evaluation of normal mean platelet volume in discriminating hyperdestructive thrombocytopenia from hypoproductive thrombocytopenia. Int J Lab Hematol. 2008 Oct;30(5):408–14.
11. Parveen S, Vimal M, Role of platelet indices in differentiating hypoproductive and hyperdestructive thrombocytopenia. Annals of Pathology and Laboratory Medicine (2017). 4 (3): A288.