

STUDY OF VARIATION IN PLATELET INDICES AND THEIR ROLE IN EVALUATION OF ADULT THROMBOCYTOPENIAS IN A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: Thrombocytopenia refers to decreased number of platelets in circulation and can result in abnormal bleeding tendencies. Thrombocytopenia resulting from increased platelet destruction are referred to as Hyper-destructive thrombocytopenia, and those caused by decreased production in the bone marrow are called Hypo-productive thrombocytopenia. Although bone marrow examination can help in establishing a final diagnosis of the cause of thrombocytopenia, it is a rather painful and time-consuming procedure. Platelet indices like MPV, PDW, P-LCR & PCT are provided as a part of routine complete blood count by modern automated blood cell analysers and provide a non-invasive, cost effective, rapid and efficient mode of evaluating the cause of thrombocytopenia. They can help the clinicians determine the etiology of thrombocytopenia, thereby avoiding or at least delaying a request for bone marrow examination. **Aims & Objectives:** To determine the variation in platelet indices (MPV, PDW, P-LCR, and PCT) in patients with thrombocytopenia and to evaluate their efficiency in differentiating hypo-productive thrombocytopenia from hyper-destructive thrombocytopenia. **Materials and Methods:** A hospital-based case-control study was carried out in a tertiary care centre of Northeast India from October 2023 to September 2024. 30 patients were categorized in the hyper-destructive group and 30 patients in the hypo-productive group with 30 healthy individuals acting as controls. The clinical details including investigations of the patients were taken from case records. Patients were categorized into Hyper-destructive and Hypo-productive groups based on the predominant mechanism of thrombocytopenia. Venous blood samples were obtained in 5ml EDTA tubes and analysed in automated haematology analysers, which generated the values for platelet count and platelet indices. The efficiency of platelet indices in differentiating hyper-destructive thrombocytopenia from hypo-productive thrombocytopenia was evaluated. The statistical analysis was done using SPSS version 20.0. Chicago, SPSS Inc. **Results:** The most common age group of patients was 18-30 years and most of them were male. The most important causes of hyper-destructive thrombocytopenia were ITP (30.0%) & Dengue (20.0%); whereas Acute leukemia (43.3%) & Megaloblastic anemia (20.0%) were the common causes of hypo-productive thrombocytopenia. The mean platelet count was comparatively higher in the hypo-productive group. The MPV, PDW & P-LCR were higher in the hyper-destructive group as compared to the patients in hypo-productive group and the healthy controls. All these findings were statistically significant (p-value<0.05). **Conclusion:** The findings of this study indicate that platelet indices such as MPV, PDW, and P-LCR are higher in the hyper-destructive group than in the hypo-productive group. Since they are rapidly available and cost effective, platelet indices can guide the clinician in categorizing a thrombocytopenia patient into hyper-destructive or hypo-productive group and decrease the need for bone marrow examinations which are painful and time consuming.



INTRODUCTION

Thrombocytopenia may be defined as a subnormal number of platelets in the circulating blood. It is the most common cause of abnormal bleeding. It may be the result of inadequate production of platelets or their peripheral destruction. The former are known as hypo-proliferative thrombocytopenia, while the latter are categorized as hyper-destructive thrombocytopenia.^[1]

Hypo-proliferative or hypo-productive thrombocytopenia results from primary or secondary bone marrow diseases such as aplastic anemia, acute leukemia, megaloblastic anemia, myelodysplastic syndrome, amegakaryocytic thrombocytopenic purpura, and in post-chemotherapy patients.^[2] Whereas hyper-destructive thrombocytopenia is seen in immune thrombocytopenic purpura (ITP), dengue, disseminated intra-vascular coagulation (DIC), and secondary ITP. Congestive splenomegaly because of chronic infection, myeloproliferative disease, lymphomas, homozygous sickle cell disease, haemoglobin C disease, Gaucher's disease & thalassemia major can cause platelet sequestration in spleen.^[3]

Although bone marrow examination is the gold standard in determining the etiology of thrombocytopenia, it should not be the first line of investigation because it is invasive, painful and carries risk of excess bleeding.^[4,5]

Platelet indices include Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Platelet-large cell ratio (P-LCR) and Plateletcrit (PCT), which are provided as a part of routine complete blood count by modern automated blood cell analysers. These parameters form a preliminary, non-invasive, cost effective, rapid and efficient mode of evaluating the cause for thrombocytopenia.^[5]

Platelet indices provide valuable information and help clinicians determine the etiology of thrombocytopenia thereby avoiding or at least delaying a request for bone marrow examination.^[6]

The present study attempts to find the usefulness of these platelet indices (MPV, PDW, P-LCR and PCT) derived from the automated analyser on the principle of impedance in discriminating between hyper-destructive or hypo-productive causes of thrombocytopenia.

Aims & Objectives

To determine the variation in platelet indices (MPV, PDW, P-LCR, and PCT) in patients with thrombocytopenia and to evaluate their efficiency in differentiating hypo-productive thrombocytopenia from hyper-destructive thrombocytopenia.

MATERIALS AND METHODS

The study was designed as a case control study and carried out over a period of 1 year from October 2023 to September 2024. A total of 60 cases of

thrombocytopenia were included in the study and 30 normal individuals acted as controls.

Inclusion criteria included adult patients between 18 to 80 years of age, with a platelet count of less than 1,50,000/microliter, regardless of gender.

Exclusion criteria included cases of Pseudo-thrombocytopenia, patients on anti-platelet drugs or other drugs causing thrombocytopenia, any recent history of blood transfusion and pregnant women. Written informed consent was obtained from the patients or their guardians and Clearance certificate taken from the Institutional ethics committee for conducting the study.

The clinical details including investigations were taken from case records and by using case collecting proforma. Venous blood samples were obtained in 5ml EDTA tubes and analyzed in automated hematology analysers (SYSMEX XN 550, SYSMEX 1000 or SYSMEX 580), which generated the values for platelet count and platelet indices. The analysers work on the impedance principle and platelets are classified as pulses representing cells from 2 to 20 fl. In each case a Leishman-stained peripheral blood smear was also reviewed.

By combining the clinical findings, investigation reports and platelet indices, thrombocytopenia patients were categorized into Hyper-destructive and Hypo-productive groups based on the predominant mechanism of thrombocytopenia. The statistical analysis was done using SPSS version 20.0. Chicago, SPSS Inc.

RESULTS

In this study the patients with thrombocytopenia were divided into two groups: 30 patients were in the hyper-destructive group, and the other 30 were in the hypo-productive group. The control group comprised of 30 healthy individuals. Platelet indices, including Platelet count, MPV, PDW, P-LCR, and PCT were gathered and the findings were analyzed for each group.

Age & Gender distribution

All the patients included in the study were between the ages of 18-70 years, and most cases (41.67%) were found in the age bracket of 18-30 years. Among the two categories, most cases (66.67%) in the hyper-destructive group fell in the 18-30 years age group, whereas in the hypo-productive group most cases (40.0%) were found in the age group of 41-50 years. Control individuals were aged between 20-58 years with a median age of 34.5 years.

Based on gender, majority of the patients (40) and control individuals (20) were male.

Etiology-wise distribution

The most important causes of Hyper-destructive thrombocytopenia were ITP (30.0%) & Dengue (20.0%); whereas viral infection, sepsis, chronic kidney disease (CKD) & DIC were responsible for the rest. Among the Hypo-productive thrombocytopenia's, Acute leukemia affected most

of the patients (43.3%), followed by Megaloblastic anemia (20.0%); whereas other causes were Aplastic anemia, Liver diseases, Plasma cell dyscrasias & hypocellular marrow.

Variation in Mean Platelet indices

The variation in Mean platelet indices between the hyper-destructive, hypo-productive & healthy controls are shown in table 3. The differences between the variables among the Hyper-destructive vs Hypo-productive group, Hyper-destructive vs Control group & Hypo-productive vs Control group were statistically significant (p-value < 0.05) in all the cases.

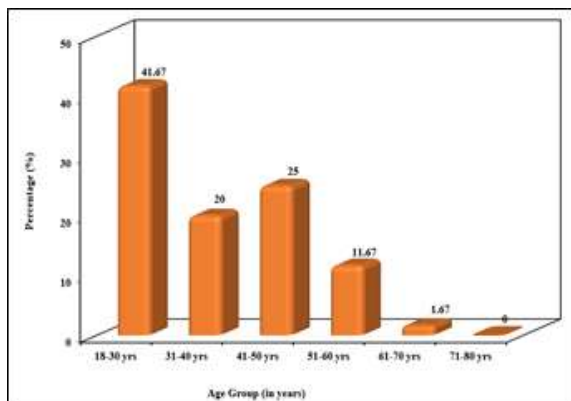


Figure 1: Age Wise distribution of all cases

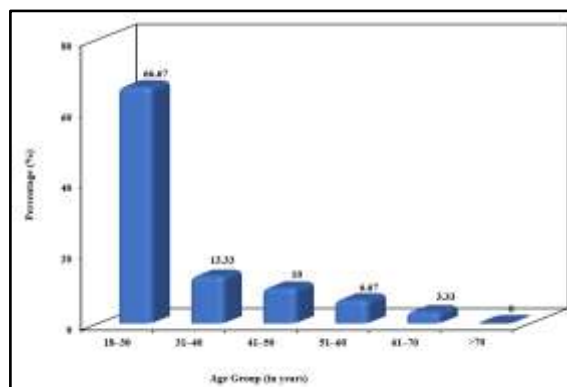


Figure 2: Age wise distribution in Hyperdestructive Group

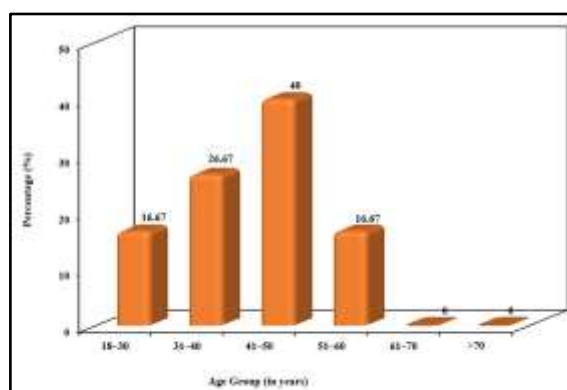


Figure 3: Age wise distribution in Hypo-productive group

Table 1: Distribution of cases in Hyper-destructive group

Etiology	Number (n = 30)	Percentage (%)
I TP	9	30.00
Dengue	6	20.00
Viral Infection	5	16.67
DIC Sepsis	4	13.33
DIC	3	10.00
CKD	3	10.00

Table 2: Distribution of cases in Hypo-productive group

Etiology	Number (n = 30)	Percentage (%)
Acute Leukemia	13	43.33
Megaloblastic Anemia	6	20.00
Liver disease	4	13.33
Plasma Cell Dyscrasia	3	10.00
Aplastic anemia	2	6.67
Hypocellular marrow	2	6.67

Table 3: Variation in Mean Platelet indices between the three groups

Variables	Hyper-destructive (Mean ± SD)	Hypo-productive (Mean ± SD)	Controls (Mean ± SD)
Platelet Count ($10^3/\mu\text{L}$)	36.56±13.99	46.03±20.57	244.13±59.07
MPV (fl)	12.73 ±2.60	10.03±1.34	10.53±0.88
PDW (fl)	19.57±3.02	11.13±2.84	11.48±0.91
P-LCR (%)	59.79±65.48	28.33±6.38	30.06±5.98
PCT (%)	0.04±0.02	0.05±0.03	0.24±0.06

DISCUSSION

Platelets play a significant role in normal haemostasis, thrombosis and in various bleeding disorders⁷. Thrombocytopenia is defined as a Platelet

count less than 1,50,000 / μL . They are a prevalent finding in many diseases.^[8]

The modern automated analysers provide values of platelet indices and have become invaluable in evaluating cases of thrombocytopenia. This has

helped in rapid diagnosis and avoidance of painful bone marrow analysis in many cases.

In the present study, 60 cases of thrombocytopenia were included and they were subsequently divided into Hyper-destructive and Hypo-productive groups. There was male predominance, similar to findings of Saran et al⁸ & Shah et al.^[9] Majority of patients with hyper-destructive thrombocytopenia were in the age group of 18 to 30 years and in hypo-productive group were between 41 to 50 years.

Mean Platelet Count

In the present study, mean platelet count was found to be significantly higher (p-value<0.05) in the Hypo-productive group than in the Hyper-destructive group, which was similar to the findings of Peddaverannagari T et al,^[10] but varied with the findings of Rajashekar et al.^[11] A lower mean platelet count in Hyper-destructive thrombocytopenia means more severe platelet destruction occurs in such conditions.

Mean Platelet Volume (MPV)

MPV is the parameter that measures the average platelet size as the mean corpuscular volume does for red blood cells.^[8] Normal range of MPV is approximately 7.2 to 11.7 fl.^[12] In the present study the mean MPV in the Hyper-destructive group was 12.73 ± 2.60 fl, which was higher than in the Hypo-productive group (10.03 ± 1.34 fl) and this was statistically significant (p-value<0.001). This correlates with the studies of Ntaios et al,^[13] Kaito et al,^[14] & Parveen et al.^[15] In conditions where platelets are destroyed, new younger and larger platelets are pushed into peripheral blood from an active bone marrow, thus increasing the MPV.^[16]

Platelet Distribution Width (PDW)

PDW measures the variation in platelet size¹⁷ and helps in differentiating between decreased production or destruction of platelets.^[7,12] Its normal range is 10.0%–17.9%.^[17] In the present study, mean

PDW of Hyper-destructive group was 19.57 ± 3.02 fl, which was significantly (p < 0.001) higher than that of the Hypo-productive group (11.13 ± 2.84 fl). This correlated with study of Kaito et al¹⁴. Whereas Parveen et al,^[15] did not find statistically significant difference among the two groups. The elevated PDW in hyper-destructive cases is due to presence of large young platelets along with normal sized ones in circulation.

Plateletcrit (PCT)

Plateletcrit (PCT) measures total platelet mass as a percentage of volume occupied in the blood. The normal range for PCT is 0.22–0.24%.^[18] The mean PCT of patients with thrombocytopenia was significantly lower than that of the control group (0.24 ± 0.06) %. Among the patients, the PCT in hyper-destructive group (0.04 ± 0.02) % was lower compared to the hypo-productive group (0.05 ± 0.03) %. The findings compare well with those of Parveen et al,^[15] whereas Saran et al⁶ found a higher PCT in the hyper-destructive group. PCT correlates directly with platelet count.^[16]

Platelet-Large Cell ratio (P-LCR)

P-LCR is the percentage of platelets larger than 12 fl in circulation, representing those platelets that are metabolically and enzymatically more active than small platelets. Its normal range varies between 15 to 35%.^[18]

The following table shows comparison of P-LCR (in %) of the present study with studies of other authors: From table 4, it can be seen that the findings of the current study compare with those of previous studies. The mean P-LCR of the hyper-destructive group is significantly higher (p-value<0.011) than the other groups. This is because young large platelets are produced as a compensatory mechanism in destructive conditions. P-LCR is inversely related to platelet count and directly related to MPV and PDW.^[20]

Table 4: Comparison of P-LCR (in %) between the two groups

Study	Hyperdestructive (Mean ± SD)	Hypoproductive (Mean ± SD)	'p value'
Kaito et al ¹⁴	42.2±1.5	25.7±1.1	<0.001*
Mittal et al ¹⁹	53.64±8.98	48.85±8.03	<0.023*
Present study	59.79±65.48	28.33±6.38	<0.011*

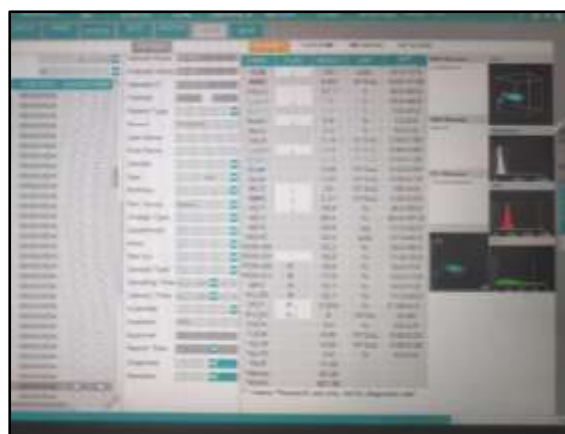


Figure 4: CBC with Thrombocytopenia

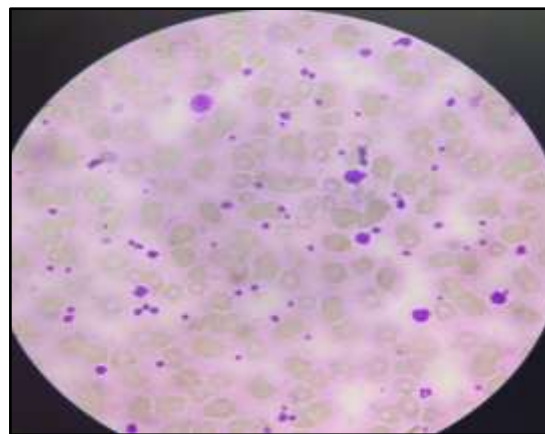


Figure 5: Large platelets in peripheral smear

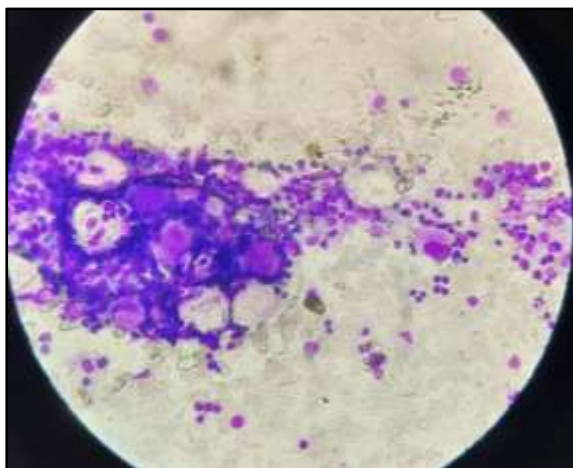


Figure 6: ITP – Megakaryocytic hyperplasia in bone marrow aspiration

CONCLUSION

In conclusion, the findings of this study indicate that platelet indices such as MPV, PDW, and P-LCR are higher in the hyper-destructive group than in the hypo-productive group. In contrast, the mean platelet count and PCT are higher in the hypo-productive group.

A combined interpretation of these readily available platelet parameters can help distinguish the underlying cause of thrombocytopenia and assist clinicians in categorizing patients into hyper-destructive or hypo-productive groups. This may help avoid painful and time-consuming bone marrow procedures and aid clinicians in selecting the most appropriate treatment modality for patients.

However, our study had certain limitations, including a small sample size and short study duration. Some findings did not correlate with previous studies, possibly due to these limitations or other demographic and geographical factors. Therefore, further large-scale studies are required for more accurate evaluation and validation of these findings.

Ethical issues & Consent: Written consent was obtained from all patients and healthy control individuals. Ethical clearance was obtained from the Institutional ethics committee.

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