



COMPARISON OF PLATELET INDICES IN HYPO-PRODUCTIVE AND HYPER-DESTRUCTIVE THROMBOCYTOPENIA

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ABSTRACT:

BACKGROUND: Thrombocytopenia is a potentially fatal illness and one of the most prevalent hematological disorders. The easiest way to differentiate between the two forms of thrombocytopenia—hyper-destructive and hypo productive—is by doing a bone marrow examination, but this is an invasive, time-consuming, and costly procedure. This study's objective was to ascertain if platelet indices have a role in differentiating between the two kinds using a non-invasive, cost-effective method of examination.

METHODS: It was cross-sectional research carried out at the Mayo Hospital, Lahore between July 1, 2021, and June 30, 2022. The approach utilized was non-probability convenience sampling. A total of 74 thrombocytopenic patients who were sent for a bone marrow aspirate and a trephine biopsy were included in the research after the sample size was established using the WHO criteria. We collected and calculated data for the patient's medical record, complete blood count (CBC), and bone marrow trephine biopsy.

RESULTS: In the hyper-productive group, the average platelet volume was 10.571.33 fl, whereas, in the hyper-destructive group, it was 11.6371.98 fl. There was a statistically significant difference between the groups ($p=0.017$). In the hypo-productive group, the platelet distribution width was 12.683.16 fl, but in the hyper-destructive group, it was 14.8113.61 fl ($p=0.014$). In the hypo-productive group, the platelet large cell ratio was 30.819.23%, but in the hyper-destructive group, it was 36.99310.25% ($p=0.010$).

CONCLUSIONS: An effective method for differentiating between hyper-destructive and hypo-productive thrombocytopenia is platelet indices.

KEYWORDS: Platelet, Thrombocytopenia, Platelet Indices

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INTRODUCTION: Megakaryocytes, also known as thrombocytes, are the precursors of platelets in the bone marrow. They primarily serve to halt bleeding by producing a primary platelet plug at the site of vascular damage while in circulation. (1) In a liter of blood, the typical platelet count ranges from 150,000 to 450,000. In a healthy individual, platelets circulate for roughly 10 days. (2) Thrombocytopenia is defined as a platelet count of fewer than 150,000. (2,3) In healthy people, the MPV varies from 6.8 to 10.4 fL, the PDW from 9 to 14 fL, and the PLCR from 15 to 35%. (4)

One of the most prevalent hematological problems, thrombocytopenia may be fatal in the event of a severe illness. Reduced platelet production (hypo-productive thrombocytopenia) or enhanced platelet disintegration are two of the several causes underlying thrombocytopenia (hyper-destructive thrombocytopenia). (5) Drugs, chemicals, radiation, leukemia, lymphoma, chemotherapy, aplastic anemia, infections including HIV, and megaloblastic anemia are the main causes of hypo-productive thrombocytopenia. Hyper-destructive thrombocytopenia has a number of different causes, including idiopathic immune thrombocytopenic purpura, systemic lupus edematous, viruses (malaria, hepatitis, HIV), drug-induced hyper-destructive thrombocytopenia (e.g., heparin), intravascular coagulation, thromboembolic hemorrhages, and enlarged Knowing whether thrombocytopenia is caused by increased platelet breakdown or reduced generation is crucial for the effective treatment of patients. (6) Bone marrow analysis is the gold standard for distinguishing between them, but it is an invasive, expensive, and time-consuming process. (7)

It is now feasible to test a variety of characteristics thanks to recent developments in automated blood cell analyzers. Platelet indicators such as platelet distribution width (PDW), mean platelet volume (MPV), and

platelet large cell ratio are among them (PLCR). (8)

According to research, platelet distribution width (PDW) is larger in hyper-destructive thrombocytopenia with a mean value of 16.070.17 and lower with a mean PDW of 12.150.25 in hypo-productive thrombocytopenia. (9)

Another research conducted in Iraq revealed that the mean platelet volume and platelet distribution width were larger in instances with hyper-destructive thrombocytopenia than in cases of hypo-productive thrombocytopenia. PDW had a mean value of 15.610.73 in patients with hyper-destruction, 13.831.75 in those with hypoproduction, and 12.330.46 and 10.081.81 in those with MPV, respectively. (10) Although these platelet indices provide some valuable information, they are not approved for regular therapeutic usage. These indicators might develop into highly helpful laboratory tests for thrombocytopenia if they are indeed instructive on platelet dynamics. (11) Therefore, thrombocytopenic purpura may be identified early by adopting a cost-effective, non-invasive, non-ionizing mode of study. (12)

This study's goals were to examine the platelet indices (PDW, MPV, and PLCR) in hypo-productive and hyper-destructive thrombocytopenia and to ascertain the function of platelet indices in separating the two types of thrombocytopenia.

METHODS: During the period of 1 July 2021 to 30 June 2022, a cross-sectional, analytical investigation was carried out in the pathology laboratory of the Mayo Hospital in Lahore. From the Mayo Hospital Ethical and Research Board, the research received approval. There were 74 people with thrombocytopenia altogether. The sample size was determined using the WHO algorithm, taking into account Pakistan's 2.3% prevalence of thrombocytopenia (9) and maintaining a 3.5% margin of error. It was done using a non-probability convenience sampling approach. The research comprised patients with verified hemoglobin levels less than 100 109/L following peripheral blood film evaluation who

were of both sexes and of all ages and attending the RMI Laboratory for a bone marrow biopsy for hematological illnesses. The research excluded patients with fictitious thrombocytopenia, pregnant individuals, and anyone using heparin, quinine, quinidine, or similar medications.

Following informed permission, a thorough medical and personal record was collected and entered into the hospital's records. The posterior iliac crest was used as the site for a trephine biopsy and bone marrow aspiration. Giemsa stain was applied on the bone marrow aspirate slide. A standardized bone marrow trephine biopsy was carried out in accordance with the protocol³, and it was analyzed using eosin and hematoxylin.

All patients had their 3 ml of venous blood collected into an EDTA vacutainer, and a full blood count was done on all of the samples to find out the number of platelets and their indices. Hemoglobin (Hb) measurement and total leukocyte count (TLC) estimates were also performed. A peripheral blood film was analyzed to determine the platelet count and rule out pseudo-thrombocytopenia. The information was gathered using a standardized proforma that included questions about the patient's demographics, platelet indices, and bone marrow results.

Using SPSS-26, the data was input and examined. For numerical variables, standard deviation and mean were computed, and a statistical comparison was made using Student's t-test with a p-value threshold of 0.05.

RESULTS: On the basis of a bone marrow examination, 47 (63.51%) of the 74

thrombocytopenic patients enrolled for the research were classified as hypo-productive and 27 (36.49%) as hyper-destructive thrombocytopenia patients. It was 33.81 years on average with ± 22.1 standard deviation. The average value MPV in the hypo-productive group was 10.57 with ± 1.33 fL standard deviation, whereas in the hyper-destructive group it was 11.637 ± 1.98 fL. There was a statistically significant difference between the groups with the p-value=0.017. PDW average value in the hypo-productive group was 12.68 with ± 3.16 fL and in the hyper-destructive group, it was 14.81 ± 3.61 fL with p-value=0.014). In the hypo-productive group, PLCR was $30.81 \pm 9.23\%$, while in the hyper-destructive group, it was $36.993 \pm 10.25\%$ and the p-value is 0.01) (Table-1).

TLC, Hb, and platelet count were other blood variables that were compared. The mean TLC for the hyper-destructive group was $7.38 \pm 4.73 \times 10^3/L$ and for the hypo-productive group was $47.94 \pm 100.35 \times 10^3/L$ and the p-value =0.040. In the hypo-productive group, the mean Hb was 8.52 ± 2.35 gm/dL, but in the hyper-destructive group, it was 11.6 ± 2.74 gm/dL (p-value = 0.001). The mean platelet count was $58.88 \pm 36.6 \times 10^3/L$ in the hyper-destructive group and $60.7437.3 \times 10^3/L$ in the hypo-productive group, with no statistically significant difference (Table 2). The leading cause of hypo-productive thrombocytopenia in patients was leukemia, followed by aplastic anemia. The bone marrow of all individuals with hyper-destructive thrombocytopenia was normocellular and had enhanced megakaryopoiesis (Table 3).

Table 1: Hyper-destructive and Hypo-productive thrombocytopenia platelet indices (Mean, Standard Deviation (S.D), and p-value)

	PLCR (%)	PDW (fL)	MPV (fL)
Hyper-destructive (n=27)	36.993	14.811	11.637
	± 10.25	± 3.61	± 1.98
Hypo-productive (n=47)	30.81	12.68	10.57
	± 9.23	± 3.16	± 1.33
p-value	0.01	0.014	0.017

Table 2: Blood test results for hypo-productive and hyper-destructive thrombocytopenia

		Platelets	Hb	TLC
Hyper-destructive (n=27)	Mean	58.88	11.6	7.38
	S.D	±36.6	±2.74	±4.73
Hypo-productive (n=47)	Mean	60.74	8.52	47.94
	S.D	±37.3	±2.35	±100.35
p-value		0.835	<0.001	0.04

Table 3: Patients with thrombocytopenia's bone marrow results

Thrombocytopenia	Bone marrow results	Frequency	Percentage
Hyper-destructive	Enhanced megakaryopoiesis in a normal-cellular bone marrow	27	36
Hypo-productive	ALL	17	23
	AML	15	20
	Multiple myeloma	4	5.5
	Aplastic anemia	4	5.5
	CLL	4	5.5
	Megaloblastic anemia	3	4.5
Total		74	100

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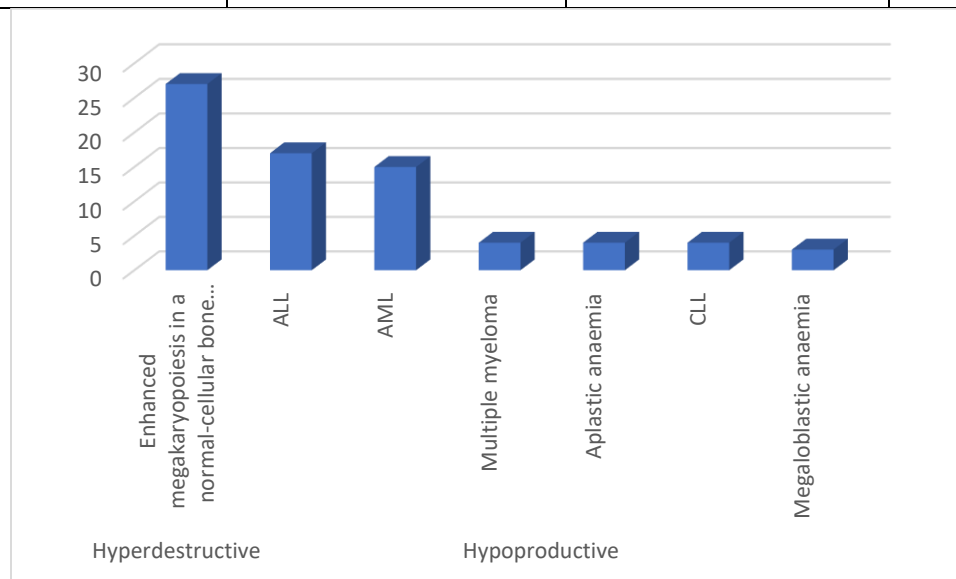


Figure 1: Patients with thrombocytopenia's bone marrow results

DISCUSSIONS: The hyper-destructive thrombocytopenic individuals in the current research had considerably greater MPV levels than the hypo-productive group. Similar studies that analyzed comparable groups came to the conclusion that MPV was considerably greater

in individuals with hyper-destructive than in those with hypo-productive thrombocytopenia. (13), MPV was found to be considerably larger in hyper-destructive than in hypo-productive thrombocytopenic individuals in similar trials comparing these two groups. (14-17) The



reason for this is that freshly created platelets are bigger than circulating platelets, and as platelets become older, they get smaller. In cases with hyper-destructive thrombocytopenia, the bone marrow actively produces platelets, which causes these patients' MPV to be greater. Despite this, several studies showed that MPV had limited specificity and sensitivity to determine the involvement of the bone marrow in thrombocytopenia. (18-20) According to another research, MPV and other platelet indices may be used to identify the kind of thrombocytopenia. (21, 22) In this investigation, PDW was shown to be considerably greater in patients with hyper-destructive thrombocytopenia than in individuals with hypo-productive thrombocytopenia. The results of the present study were in agreement with those of other studies (23-25), but they differ from those of a previous study, which claimed that the increase was not significant. This difference may be due to the earlier study's use of a different analyzer (Beckman Clouter) than ours.

In the current research, patients with hyper-destructive thrombocytopenia had considerably greater PLCR than those with hypo-productive thrombocytopenia. This is consistent with studies that found hyper-destructive thrombocytopenic individuals to have a large rise in PLCR. (26,27) However, they still came to the conclusion that PLCR may be a useful tool in the differential diagnosis of individuals with aberrant platelet counts. Some researchers claimed that this rise was not significant between the two groups. (28,29)

Another study that looked at platelet indices and platelet antibodies in thrombocytopenic patients found that hyper-destructive thrombocytopenic patients had considerably higher platelet indices than hypo-productive thrombocytopenic patients. It was concluded that these indices could be used as an effective diagnostic tool to identify the type of thrombocytopenia. (30)

CONCLUSIONS: A trustworthy technique for differentiating between hypo-productive

and hyper-destructive thrombocytopenia is platelet indices. Patients with thrombocytopenia may find this diagnostic technique advantageous with regard to invasion, time, and cost. It is advised that more research with a bigger sample size be done to confirm the results of this research.

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