ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 3.4
IJAR 2014; 1(1): 604-607
www.allresearchjournal.com
Received: 09-05-2014
Accepted: 17-06-2014

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Evaluation of thrombocytopenia, specifically focusing on platelet indices

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Abstract
Background: When determining the etiology of thrombocytopenia, it is crucial to ascertain whether the rise in platelet hyperdestruction or hypoproduction is the primary cause, after ruling out splenic sequestration.
Methods: Researchers at the DD Medical College & Hospital, Tiruvallur, Chennai, India conducted an analysis of data collected from cameras that were positioned ahead of time between April 2013 to March 2014. Thrombocytopenia patients were divided into two categories: hyperdestructive and hypoproductive.
Results: Thirty-eight of the fifty patients had hypoproductive thrombocytopenia and twelve had hyperdestructive thrombocytopenia. These individuals were included in the analysis. Of the 21 patients in total, all of the cases in the former category were immune-mediated thrombocytopenia (ITP). In contrast to hypoproductive thrombocytopenia (MPV 9.42±3), hyper destructive thrombocytopenia (MPV 12.61±1.88) had a much greater value. In a similar vein, the former group's PDW (15.57±1.23) was higher than the later group's (13.36±4.87).
Conclusion: Platelet indices can provide some initial insight into the type of thrombocytopenia, such as hyperdestructive or hypoproductive. This will assist in guiding decisions about patient care and perhaps relieve some people's need for bone marrow testing. Furthermore, obtaining a second blood sample or paying an additional fee are not necessary in order to ascertain platelet indices.

Keywords: Hyperdestructive, thrombocytopenia, bone marrow, platelet

1. Introduction
Platelet count, mean platelet volume (MPV), platelet distribution width (PDW), and plateletcrit (Pct) are a few of the significant platelet parameters that are currently reported by automated analyzer [1]. Four likely reasons include dilutional loss, abnormal platelet distribution, hyperdestructive thrombocytopenia, and hypoproductive thrombocytopenia. several than the basic platelet count, there are several platelet indications that can be used to determine the reason of thrombocytopenia [2]. The mean platelet volume, platelet distribution width, and platelet crit are some examples of these platelet markers. As an indicator of how well the bone marrow is producing platelets, the mean platelet volume (MPV) evaluates the typical size of platelets found in blood. It gauges how much platelets vary from one another and is a measurement of platelet anisocytosis [3-5]. Similar to the haematocrit, it is a measurement of the total number of platelets circulating in a specific volume of blood and is calculated by multiplying the platelet count by the mean platelet volume. Thrombocytopenia is defined by four main variants, each of which has a unique collection of underlying illnesses. This group includes disruptions in platelet distribution, platelet synthesis (hypo-productive), platelet destruction (hyperdestructive), and dilutional loss (hypo-dilute) [6-8].
Hypoproductive thrombocytopenia may be caused by specific megakaryocyte suppression, as seen in congenital thrombopoietin receptor mutation, May-Hegglin syndrome, Wiscott-Aldrich syndrome, drugs, chemicals, and viral infections; or systemic bone marrow failures, as seen in haematological malignancies.

Either of these two types of megakaryocyte suppression may give rise to hypoproductive thrombocytopenia. Immunological processes, including idiopathic or primary autoimmune illness, secondary infections (viral or parasitic), drug-induced hyper-destructive thrombocytopenia, post-transfusion purpura, and disseminated intravascular hemolysis, are the most common causes of hyper-destructive thrombocytopenia [6]. A condition called dilutional thrombocytopenia, which causes an uneven distribution of platelets throughout the body, can be brought on by a large blood transfusion. The MPV and PDW rise in response to platelets being activated because they grow and alter morphologically.

An automated electronic Coulter machine is used to calculate the platelet count and platelet indices. This study aims to determine whether platelet indices are useful in the evaluation of thrombocytopenia and whether they may be utilized to make a preliminary diagnosis of thrombocytopenia [7]. In order to assess thrombocytopenia, our research will try to ascertain the usefulness of platelet indices in diagnosing the condition, the connection between platelet indices and abnormalities in the bone marrow, and the relationship between platelet count and platelet indices. That's the kind of thing we wanted to achieve.

Methodology

Researchers from DD Medical College & Hospital, Tiruvallur, Chennai, India, in the haematology branch of the Department of Pathology, conducted a prospective observational and case control study from April 2013 to March 2014.

The investigation did not pose any moral dilemmas. Written informed consent was acquired by each study participant. The present investigation examined the clinical importance of platelet volume features obtained using an automated blood cell counter, as well as the age-related etiology of thrombocytopenia in the individuals. The healthy patients who visited for their yearly physicals provided as examples of the norm for the controls.

Inclusion criteria

- Every patient whose white blood cell and platelet levels are low.

Exclusion criteria

- Individuals who have pseudothrombocytopenia.
- Individuals who had a platelet transfusion during the last 10 days.
- Individuals experiencing coagulation problems.

Results

For the study, 50 participants were used. This study examined patients with thrombocytopenia, which is characterized by a platelet count of less than 1,500,000. An automatic blood cell counter was used to collect platelet data and assess the condition's age-related evolution. This study sought to determine whether platelet measurements could be useful in distinguishing between hypoproductive and hyperdestructive thrombocytopenia.

Table 1: Age distribution in case groups for hyperdestructive and hyperdestructive

Sr. No.	Age (Years)	No. of cases
1.	11 to 20	10
2.	21 to 30	8
3.	31 to 40	14
4.	41 to 50	11
5.	51 to 60	5
	61 to 70	2
	Total	50

The bulk of adults are divided into age groups that span from 11 to 70 years old. The age range of 31 to 40 years old has the greatest number of occurrences, followed by the age range of 41 to 50 years old, based on the data displayed in the above table.

Mean age in the groups

The age distribution of the individuals with hyperdestructive thrombocytopenia was 13.92 years with a mean of 45.33 years. The mean age of the group of individuals with hypoproductive thrombocytopenia was 40.51 years, with a standard deviation of 14.91 years. With a standard deviation of 14.63 years, the average age of all the patients was 42.2 years.

Table 2: Aetiology wise distribution of patients in hypo productive thrombocytopenia

Sr. No.	Diagnosis	No. of Patients
1.	Megaloblastic anaemia	24
2.	Post chemotherapy	10
3.	Lymphoma	5
4.	CML	4
5.	Acute leukemia	2
	Total	45

The distribution of instances based on the hyperdestructive genesis. Immune-mediated thrombocytopenia was found to be the etiology of forty cases, or 100% of the cases.

Table 3: Thrombocytopenia with hyperdestructive and hypoproductive patterns in MPV

Cause		TP	FP	TN	FN	Sensitivity specificity	
Hyper-Destructive	MPV	14	04	16	03	98.4%	83.7%
	PDW	4	15	21	0	96.9%	58.5%
	Pct	2	20	1	22	15.1%	9.7%
Hypo-Productive	MPV	11	26	37	0	97.2%	67.4%
	PDW	31	04	36	2	95.3%	86.8%
	Pct	4	35	0	39	11.6%	0.01%

It was observed that hypodestructive thrombocytopenia had lower mean values for MPV, PDW, and Pct than the other kind of thrombocytopenia when comparing the platelet characteristics (MPV, PDW, and Pct) in the two groups of thrombocytopenia (cases and controls).

To determine the diagnostic sensitivity and specificity of their techniques, the authors of this study examined patients

with and without hyperdestructive and hypoproductive thrombocytopenia. Patients had to be categorized as true positives, true negatives, false positives, and false negatives before sensitivity and specificity could be determined. Between the two groups, there were statistically significant variations in platelet counts, mean platelet volume, and platelet distribution width (p 0.00017, p 0.00001, and p 0.00002, respectively). The proportion, 0.01755, is not noteworthy.

Discussion

Megakaryocytes, or highly complex anucleate cells, are the source of platelets seen in bone marrow. Platelets, when properly activated, become extraordinary cells that may contract and release chemicals that are physiologically active. A well-made peripheral blood film can reveal a lot about the number, size, distribution, and structure of platelets. If there is an artifact, a misdiagnosis could happen. Automated cell counters are growing in popularity in both developed and developing countries due to the reliability of the data they offer.

In this study, we evaluated the usefulness of platelet parameters obtained by the former in the differential diagnosis of hyperdestructive and hypoproductive thrombocytopenia [8], by comparing the results of bone marrow examinations with those of the automated blood cell counter to ascertain the etiology of thrombocytopenia. The patients were adults, both 11 years old and 70 years old. Between the ages of 41 and 50, where 18 cases were discovered, thirty percent of patients are found. Next in size is the age group of 31 to 40 years old, which accounted for 14. Out of 23.3% of all cases. Participants in the current study with hyperdestructive thrombocytopenia had average ages of 45.33 13.92 and 40.51 14.91 years, respectively [9]. The mean age of patients with hypoproductive thrombocytopenia was 72 years, three decades later than that of patients with hyperdestructive thrombocytopenia, who were 49.1 years old on average. In contrast to the 1.5:1 ratio observed in studies by Rajalakshmi *et al*. [10], the male-to-female ratio in our study of patients with hyperdestructive thrombocytopenia was 2.5: 1.

The male-to-female ratio for hypoproductive thrombocytopenia was 1.20:1. Patients with hyperdestructive thrombocytopenia frequently have platelet counts below 80,000 per microliter (microL), with a median value of 60,000 microL. Between the mean platelet counts of the hyperdestructive age group and the Controls, which were, respectively, 43.5 20.9 and 228 103 55.2, there was a statistically significant difference (p 0.0001). In other words, compared to the normal form, hyperdestructive thrombocytopenia is significantly more severe. Compared to the hypoproductive group, the hyperdestructive group had higher levels of thrombocytopenia. The current analysis revealed that immune thrombocytopenic purpura was the cause of all the cases in the hyperdestructive group [11, 12]. Of the sixty thrombocytopenia instances that were examined, the hypoproductive variant was more prevalent than the hyperdestructive form. Parallel observations were made by multiple personnel. Further research into platelet indices has been spurred by studies that demonstrate the utility of platelet indices, such as mean platelet volume, platelet distribution width, and platelet count, as markers for the early diagnosis and classification of thrombocytopenia and to assess bone marrow activity in platelet disorders. When all other possible causes of thrombocytopenia have been ruled out, ITP is typically diagnosed. The peripheral blood smear showed a decrease in platelets, while the counts of red blood cells and white blood cells were normal. The aspirate of bone marrow has shown an increase in megakaryocytes but a notable decrease in platelets. Long bones have a lot of small, hypolobated megakaryocytes in their marrow.

Megakaryocytes have been shown to develop vacuolations. In the current investigation, the majority of cases with ITP showed youthful, immature, more spherical, less polypoid megakaryocytes on morphology, and relatively few mature platelet-producing megakaryocytes [13]. The differences in MPV threshold values between studies may be explained by the age of the haematological analyzer used in the investigations; older automated analyzers may have been employed in the aforementioned studies, and they were not designed to differentiate platelets from other particles of similar size, such as immune complexes, fragmented red or white blood cells, and cell debris. Furthermore, only normal-sized platelets are counted because platelets and RBCs cannot be separated. Furthermore, some studies have demonstrated that MPV is dependent on a variety of variables, including the length of time since venipuncture, the kind of anticoagulant used, the temperature at which the specimen was kept, and the mode of detection [14]. An further option is a real, underlying variance in platelet indices between populations. Regional disparities were found when Hong *et al*. analyzed platelet indices in healthy Chinese individuals from various locations using the Sysmex XT 2100. The average MPV was 12.34, with a range of 10.30 to 12.36 [15].

The platelet crit value, which indicates the proportion of platelets in a given volume, is unrelated to the severity of hypoproductive or hyperdestructive thrombocytopenia. In our investigation, the mean Pct for the hyperdestructive group was 0.05 0.04. The hypoproductive group's mean Pct was 0.11 ± 0.12. P value was found to be statistically insignificant at 0.017. Since most of our patients fell within the normal range, it was unable to distinguish between hyperdestructive and hypoproductive thrombocytopenia [16]. The findings made by Kaito *et al*. [11] and Khanna *et al*. were strikingly comparable. P-LCR index values were significantly lower in patients with myeloid insufficiency than in the control group, and significantly higher in patients with ITP. Our results demonstrated that PCT was not a helpful diagnostic method for identifying thrombocytopenia's etiology.

Conclusion

Hyperdestructive thrombocytopenia is linked to an increase in platelet indices like MPV and PDW and is usually accompanied by extremely low platelet counts. Hypoproductive thrombocytopenia is not characterized by such an increase and does not usually result in severe thrombocytopenia. The platelet counts for neither of the thrombocytopenias indicate any improvement. Platelet indices may offer crucial early information on the kind of thrombocytopenia even prior to the release of bone marrow data. They don't require an additional blood sample, extra time, or extra money to complete because they can be completed while counting blood cells.

Conflict of Interest

None.

Funding Support
Nil.

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