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Original Research Article

A Prospective Study of Platelet Indices and Their Interpretation in Thrombocytopenia at a Tertiary Care Hospital

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Abstract

Background: Thrombocytopenia is defined as a platelet count of <150 × 10^9/L, although patients with a platelet count >50 × 10^9/L are usually asymptomatic. Severe spontaneous bleeding is rare in thrombocytopenia. It is more common when the platelet count is <20 × 10^9/L, and particularly when <10 × 10^9/L.

Aims and Objectives: The present study was conducted to evaluate platelet indices and their interpretation in thrombocytopenia in a tertiary care hospital.

Materials and Methods: An observational, prospective study was conducted on 100 patients with a platelet count <150×10^3/µL were enrolled as a study group, along with another set of 50 healthy control samples with a platelet count ≥150×10^3/µL were included in the study. Four ml of venous blood was collected in an EDTA vacutainer. An auto-analyzer was used for the evaluation of the hematological profile. After evaluation of the hematological profile, 50 patients with a platelet count <150×10^3/µL were divided into each Group 1 (hyperdestruction of platelets) and Group 2 (decreased production of platelets) based on clinical and hematological details.

Results: A total of 100 thrombocytopenia cases and 50 controls were analyzed. The mean age of the patients was 42.65±16.37 year in hypo-productive, 29.45±12.74 years in hyper-destructive, and 34.50±11.68 year in control years respectively. The mean platelet count (10^3 µL) in the hypo-productive, hyper-destructive and healthy control groups was 82.50±33.25, 65.82±36.42, and 225.91±68.41 (10^3 µL) , respectively. The mean MPV in the hypo-productive, hyper-destructive and healthy control groups was 10.65±1.94 fl, 12.35±1.53 fl and 9.64±1.68 fl respectively. The mean PCT in the hypo-productive, hyper-destructive and healthy control groups was 0.08±0.06 %, 0.09±0.05% and 0.22±0.06% respectively.

Conclusion: All the platelet indices were higher in hyper-destructive thrombocytopenia as compared to hypo-productive thrombocytopenia except platelet count, whereas PCT in healthy controls was higher than that in hypo-productive and hyper-destructive thrombocytopenia patients.

Keywords: Thrombocytopenia, Platelets, Platelet Indices.

Introduction

Thrombocytopenia is defined as a platelet count of <150 × 10^9/L, although patients with a platelet count >50 × 10^9/L are usually asymptomatic. Severe spontaneous bleeding is rare in thrombocytopenia. It is more common when the platelet count is <20 × 10^9/L, and particularly when <10 × 10^9/L. Low platelets may result from reduced production in the bone marrow, increased destruction in the circulation (due to coagulopathic consumption, auto-antibodies, vasculopathy, or inflammation), hemodilution, or splenic sequestration[1-3].

Another aspect of low platelet counts is the concomitant use of medications interfering with platelet function and/or coagulation in a constantly growing population of patients with cardiovascular and thromboembolic disorders. Otherwise, adequate platelet counts in this group of patients can precipitate serious bleeding, for example, in patients treated with non-steroidal anti-inflammatory drugs (NSAIDs), especially aspirin, the most common inhibitor of platelet function. Aspirin inhibits platelet cyclo-oxygenase and blocks thromboxane A2 release, an important contributor to platelet aggregation [4-6]. Akca et al. described the time

course of platelet count in critically ill patients and showed that the mortality rate goes up to 66% in ICU patients if thrombocytopenia persists for 14 days after initial ICU admission and is reduced to 16% if the platelet levels are successfully restored. The recovery rate can also serve as an important indicator for prognosis, as survivors had an average of a 30×10^9/L x day increase, and non-survivors had a $\leq 6 \times 10^9$/L x day increase [7,8].

Aims and Objectives

The present study was conducted to evaluate platelet indices and their interpretation in thrombocytopenia in a tertiary care hospital.

Materials and Methods

The present cross-sectional prospective study was hospital-based and included 100 thrombocytopenia cases and 50 healthy control samples of both genders in the pathology department at Anugrah Narayan Magadh Medical College and Hospital, Gaya, Patna, Bihar, India, after approval from the institutional ethical committee. All the study participants were briefed about the study, and written informed consent was obtained. This study was done between January 2022 and June 2022. The study samples divided into three groups. Each group (hypo-productive, hyper-destructive, and control) has 50 cases with a similar age and sex. Keeping power (1-beta error) at 80% and confidence interval (1-alpha error) at 95%, the minimum sample size required was 60 patients; therefore, we included 100 thrombocytopenia cases and 50 healthy control samples (More than the minimum required number of cases) patients in present study.

Inclusion Criteria

This study included only those cases whose diagnosis was established by either ancillary test or bone marrow examination. All cases of thrombocytopenia with a platelet count below 1,50,000/cu mm with or without bone marrow studies, cases with sufficient clinico-hematological work up to an established clinical diagnosis, and only one sample of the single participant taken were included.

Exclusion Criteria

Patient with pseudo-thrombocytopenia and patients who have received the blood transfusion or platelet transfusion within 7 days were excluded from the study.

A total of 50 patients with a platelet count $<150\times10^3$/μL were enrolled as a study group, and another set of 50 subjects EDTA blood samples of patients with a platelet count $<150\times10^3$/μL and 50 healthy control samples with a platelet count $\geq150\times10^3$/μL were included in the study. Four ml of venous blood was collected in an EDTA vacutainer. An auto-analyzer was used for the evaluation of the hematological profile. A confirmation of the platelet count was done on a peripheral blood smear examination. Complete demographic and clinical details of all the patients were obtained. After evaluation of the hematological profile, 100 patients with a platelet count $<150\times10^3$/μL were divided into Group 1 (decreased production of platelets) and Group 2 (hyper destruction of platelets) based on clinical and hematological details.

Statistical Analysis

The data was analysed using Microsoft Excel (2016). Results were expressed as mean, frequency, and range. The statistical analysis by software statistical Package for the Social Sciences (SPSS) version 21.0 was used. The Student t-test was used for comparison of both groups. The ANOVA test was used for comparing the groups with the control.When the difference's p value was less than 0.0 5, it was considered significant.

Results

In the present prospective study, a total of 150 thrombocytopenia cases were studied and the age range of patients was between 5yr and 70 yr. Each group (hypo-productive, hyper-destructive, and control) has 50 cases with a similar age and sex. The mean age of the patients was 42.65±16.37 year in hypo-productive, 29.45±12.74 years in hyper-destructive, and 34.50±11.68 year in control years respectively. The most common age groups for thrombocytopenia in hypo-productive groups were 41–50 years, and those in the hyper-destructive group were between 21 and 30 years. A slight male preponderance was seen in the overall three groups, and the overall male to female ratio was 2.06:1 [Table 1, Figure 1].

Table 1: Socio‑demographic characteristics of cases and controls groups

Variables	No. of cases	Gender		Mean age (in years) (Mean ± SD)
		Male	Female	
Hypo-productive (Group 1)	50	36	14	42.65±16.37
Hyper‑destructive (Group 2)	50	35	15	29.45±12.74
Control group	50	30	20	34.50±11.68

SD= standard deviation

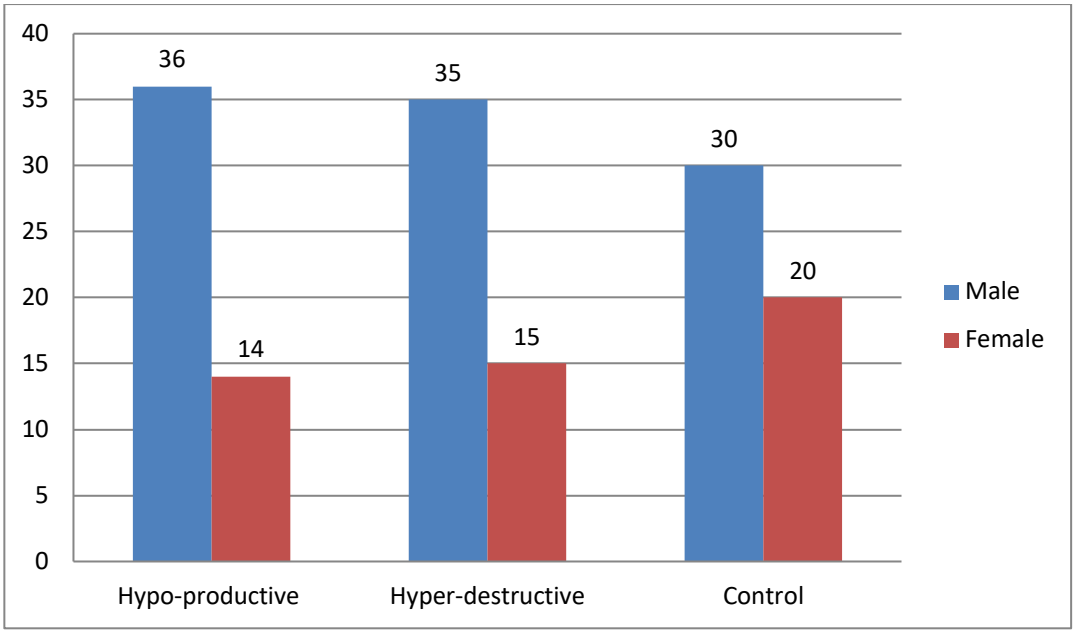

Figure 1: Socio-demographic characteristics of cases and controls groups

Table 2: Causes of thrombocytopenia

Disease Category		Mean platelet count (10^3 µL)	Mean MPV (fl)
Hypo-productive (Group 1)	Idiopathic thrombocytopenia purpura (ITP)	62.40±26.31	13.95±1.23
	Others	96.40±18.50	11.80±1.03
Hyper-destructive (Group 2)	Megaloblastic Anemia	87.00±30.62	11.78±1.50
	Aplastic Anemia	58.00±36.09	8.50±0.08
	Leukaemia	47.01±38.13	10.2±1.05
	Myelodysplastic syndrome	53.50±30.25	11.9±0.98
	Others	66.00±28.20	12.7±0.52

Platelet indices were analyzed under various clinical conditions [Table 2], and it was observed that the platelet count was lower in acute leukemia, whereas it was higher in the hypo-cellular marrow. Other platelet indices such as MPV were higher in ITP and lower in acute leukemia.

The mean platelet count (10^3 µL) in the hypo-productive, hyper-destructive and healthy control groups was 82.50±33.25, 65.82±36.42, and 225.91±68.41 (10^3 µL), respectively.

The mean MPV in the hypo-productive, hyper-destructive and healthy control groups was 10.65±1.94 fl, 12.35±1.53 fl and 9.64±1.68 fl respectively. The mean PCT in the hypo-productive, hyper-destructive and healthy control groups was 0.08±0.06 %, 0.09±0.05% and 0.22±0.06% respectively. The mean PDW in the hypo-productive, hyper-destructive and healthy control groups was 16.32±1.07fl, 17.92±1.16fl and 14.50±1.67fl respectively. Between hypo-production, hyper-destructive and healthy controls groups the platelet count and the platelet indices were compared. The platelet count, MPV, PCT, and PDW between the groups were statistically significant [Table 3].

Table 3: Comparison of mean platelet count and mean platelet indices between hypo‑productive, hyper‑destructive, and healthy controls groups

Variables	Hypo‑productive	Hyper‑destructive	Control	P value
Platelet (10^3 µL)	82.50±33.25	65.82±36.42	225.91±68.41	<0.002
MPV(fl)	10.65±1.94	12.35±1.53	9.64±1.68	
PCT (%)	0.08±0.06	0.09±0.05	0.22±0.06	
PDW (fl)	16.32±1.07	17.92±1.16	14.50±1.67	

MPV ‑ Mean Platelet Volume, PCT‑ Plateletcrit, PDW ‑ Platelet Distribution Width

On comparing among the groups, the platelet count, PCT, and PDW in normal versus hypo-productive and normal versus hyper-destructive were statistically significant (p <

0.05). All the platelet indices were higher in patients with hyper-destructive thrombocytopenia as compared to those with hypo-productive thrombocytopenia, except platelet count, whereas PCT in healthy controls was higher than that in patients with hypo-productive and hyper-destructive thrombocytopenia.

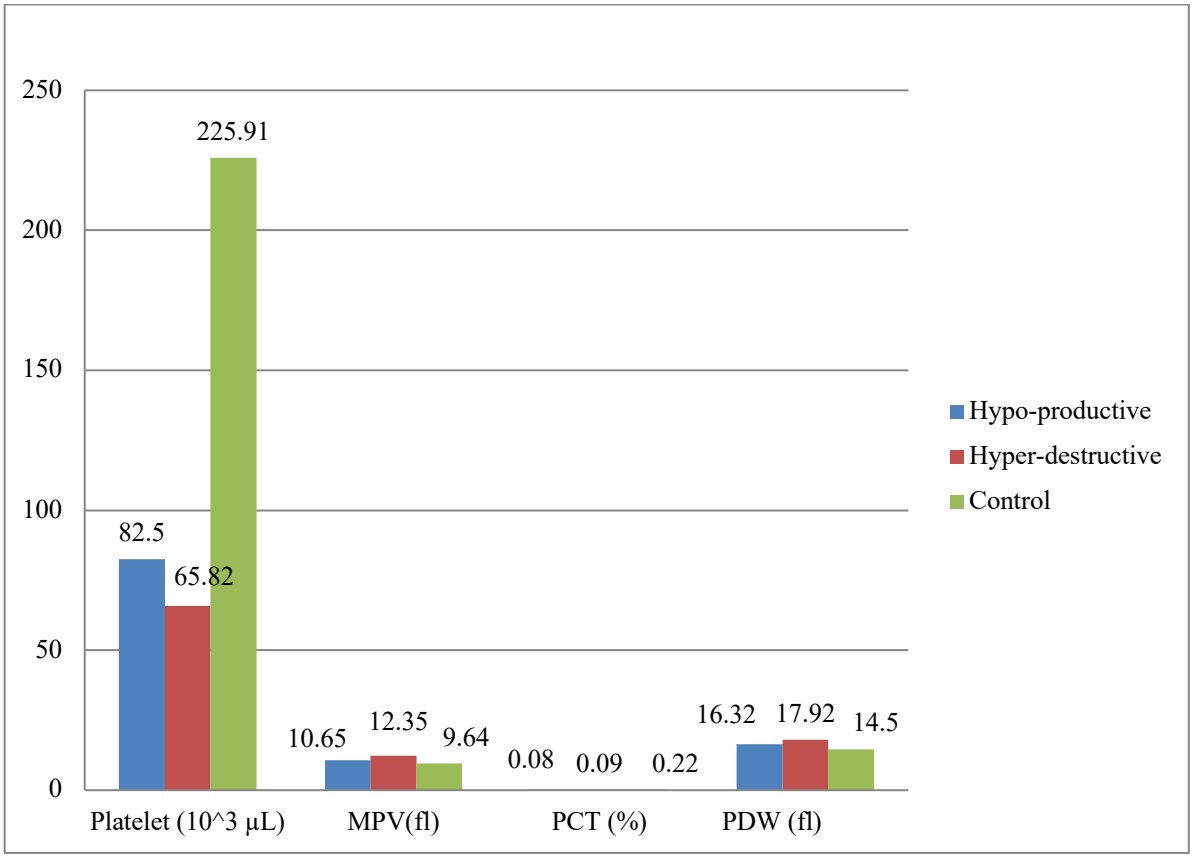

Figure 3: Comparison of the mean value of platelet count and platelet indices

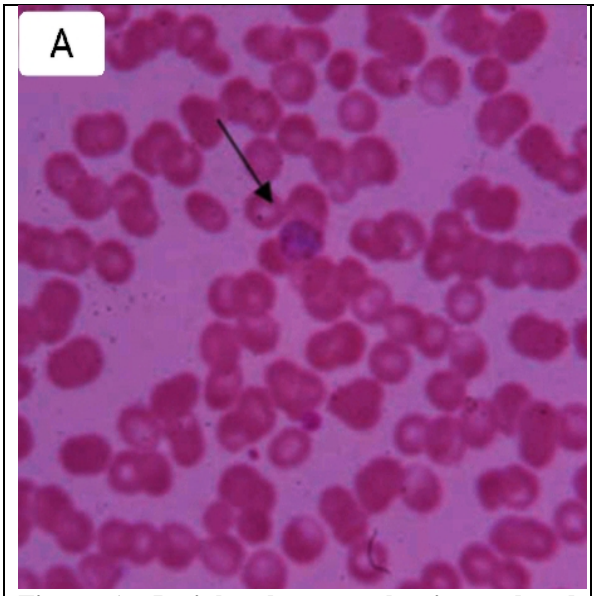

Figure A: Peripheral smear showing reduced platelet count with malarial parasite (Plamodium vivax schizont form-Leishman stain)

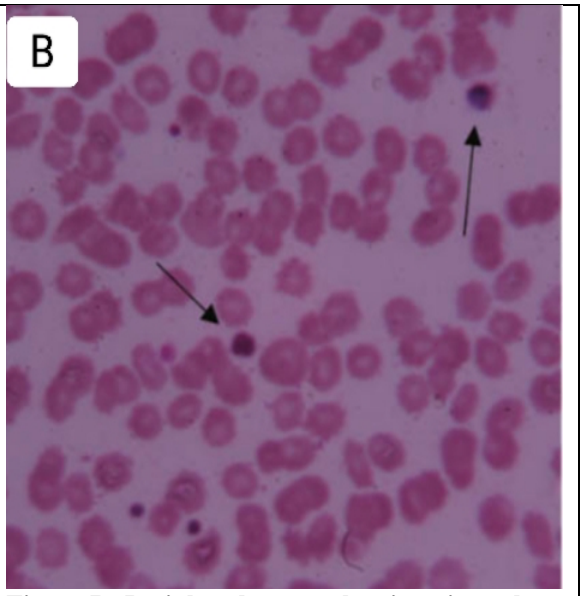

Figure B: Peripheral smear showing giant platelets in dengue fever (Leishman stain)

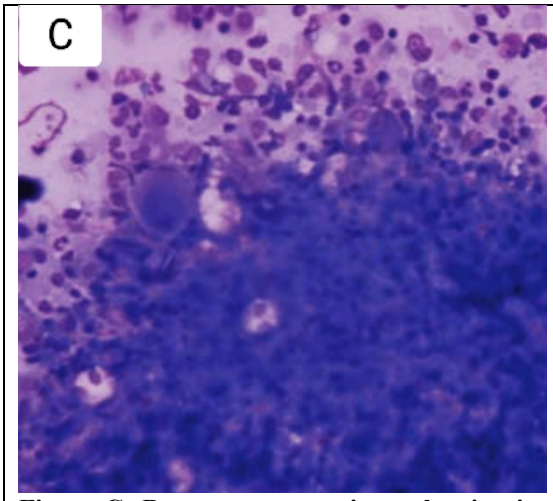

Figure C: Bone marrow aspirate showing increased megakaryocytes in immune thrombocytopenic purpura (1000x, Giema stain)

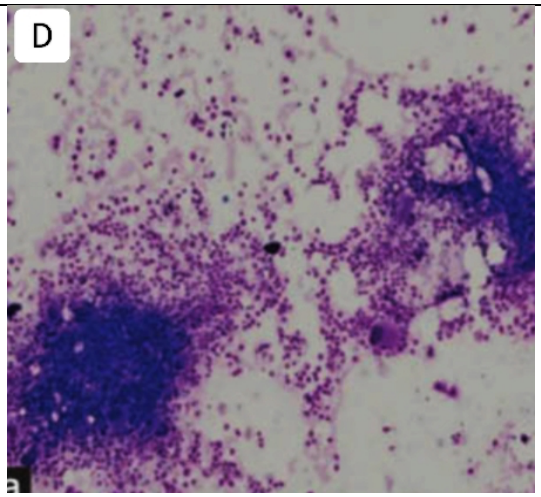

Figure D: Bone marrow aspirate showing increased mega karyo cytes in immune thromb ocyto pe nic purpura (40X Giema stain)

Discussion

Platelets play a vital role in the primary hemostasis. A recent development in technology has made it possible to know platelet indices such as MPV, PCT, and PDW with an automated hematology analyser [9].

The mean age of the patients was 42.65±16.37 year in hypo-productive, 29.45±12.74 years in hyper-destructive, and 34.50±11.68 year in control years respectively. A slight male preponderance was seen in the overall three groups, and the overall male to female ratio was 2.06:1. The mean age group of the present study in hypo-productive thrombocytopenia and hyper-destructive thrombocytopenia was similar to that in the previous study [9]. Male predominance in our study was similar to that in other studies [10].

Platelet counts were higher in the hypo-productive group than in the hyper-destructive group in previous studies, [11] which is similar to our study. However, in a few studies, [9] the mean platelet count in the hyper-destructive group was more than that in the hypo-productive group.

In our study, the cutoff value of MPV was 10.65±1.94 fl in the hypo-productive group and 12.35±1.53 fl in the hyper-destructive group which was similar than those in previous study done by Negash M et al. [9] , reported MPV values of 9.7 fl for the hypoproductive group and 12.4 fl for ITP patients and the value of MPV was significantly different between the hypo-productive and hyper-destructive groups. Numbenjapon et al. [12] proposed a cutoff value of 7.9 fl for MPV, which was lower than that previously reported, and also reported that MPV can be used to distinguish hypo-productive from hyper-destructive thrombocytopenia. A low MPV is associated with bone marrow suppression and an increased risk of bleeding [13].

In present study, on comparing among the groups, the platelet count, PCT, and PDW in normal versus hypo-productive and normal versus hyper-destructive were statistically significant ($p < 0.05$). All the platelet indices were higher in hyper-destructive thrombocytopenia as compared to hypo-productive thrombocytopenia except platelet count, whereas PCT in healthy controls was higher than that in hypo-productive and hyper-destructive thrombocytopenia patients.

The variation of platelet indices in establishing the etiology of thrombocytopenia was studied in a study conducted by Saran K. et al. [14] The study group was classified into two groups: hypo-productive and hyper-destructive. The mean platelet count (10^3 µL) in the normal, hypo-productive, and hyper-destructive groups was 232.03 ± 74.84, 73.00 ± 36.52, and 68.28 ± 38.24, respectively. The MPV and mean PCT in the normal, hypo-productive, and hyper-destructive groups were 9.46 ± 1.68 fL, 8.99 ± 1.49 fL, and 11.35 ± 1.35 fL, and 0.22 ± 0.06%, 0.07 ± 0.04%, and 0.08 ± 0.05%, respectively. The mean PDW in the normal, hypo-productive, and hyper-destructive groups was 15.66 ± 1.76 fL, 17.63 ± 1.01 fL, and 18.32 ± 1.10 fL, respectively. Platelet indices such as MPV, PCT, and PDW are higher in the hyper-destructive group and may discriminate hyper-destructive from hypo-productive causes of thrombocytopenia.

In another study conducted by Pogorzelska K et al. [15] The most frequently evaluated parameters are mean platelet volume (MPV), platelet diversity index (PDW), platelet criteria (PCT), and the presence of larger platelets (P-LCRs platelet larger cell ratio). The values of platelet indices (PI) were elevated in patients suffering from type 2 diabetes mellitus, myocardial infarction, cancer, or acute

surgical conditions, such as appendicitis. Platelet indices may have prognostic and predictive value in numerous conditions. In another study conducted by Shah J et al., [16] the authors evaluated the utility of platelet indices (MPV and PDW) in differentiating the etiology of thrombocytopenia. MPV and PDW, along with platelet count, can be used as adjunct laboratory tools for early screening of the underlying cause of thrombocytopenia, which helps clinicians with targeted therapies in clinical management.

The limitations of study: The sample size would have needed to be large to establish statistical significance; splenic sequestration was not considered a cause of thrombocytopenia, which was one of the study's shortcomings.

Conclusion

In present study, Platelet indices such as MPV, PCT, and PDW are significantly higher in hyper-destructive causes of thrombocytopenia and may discriminate between hyper-destructive and hypo-productive causes of thrombocytopenia. In the majority of patients, it may help in delaying or avoiding unnecessary, invasive bone marrow examinations. For segregating the hyper-destructive and hyperproductive causes of thrombocytopenia, the more statistically significant parameter is MPV. Thus, in all cases of thrombocytopenia, the clinicians need to look into platelet indices, which are akin to RBC indices, which can help in arriving at the probable pathophysiology of thrombocytopenia.

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