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ORIGINAL ARTICLE

# Role of Immature Platelet Fraction in Assessing Diagnosis and Prognosis in Thrombocytopenia

Alka Mathur

Assistant Professor, Department of Pathology, Sri Aurobindo Institute of Medical Sciences, Indore, Madhya Pradesh, India

***ABSTRACT:***

**Background:** Thrombocytopenia is a common clinical problem with diverse etiologies, ranging from peripheral platelet destruction to bone marrow failure. The immature platelet fraction (IPF) has emerged as a valuable biomarker for differentiating these causes and predicting patient outcomes. **Aim:** To measure the IPF percentage in various thrombocytopenic groups and evaluate its diagnostic and prognostic significance. **Material and Methods:** This prospective observational study included 85 patients with thrombocytopenia. Patients were classified into hyperdestructive, hypoproductive, and megaloblastic groups. Age, sex, platelet counts, and IPF levels were recorded using an automated hematology analyzer. IPF values were compared across diagnostic groups, and minimum-maximum IPF ranges were analyzed. **Results:** The majority of cases were in the 21–40-year age group with slight female predominance. Hyperdestructive groups showed significantly elevated IPF (95.8% with IPF >7%), particularly in immune thrombocytopenic purpura (IPF up to 57.8%), malaria, and dengue. Hypoproductive groups like aplastic anemia and leukemia showed low IPF values. Megaloblastic anemia showed intermediate IPF elevation. These patterns helped differentiate between peripheral destruction and marrow failure states. **Conclusion:** IPF is a useful, non-invasive marker for differentiating the etiology of thrombocytopenia and predicting recovery, making it an essential tool in the management of thrombocytopenic patients.

**Keywords:** Immature platelet fraction, thrombocytopenia, ITP, bone marrow failure, dengue, malaria, platelet recovery

**Corresponding author:** Alka Mathur, Assistant Professor, Department of Pathology, Sri Aurobindo Institute of Medical Sciences, Indore, Madhya Pradesh, India

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## INTRODUCTION

Thrombocytopenia, defined as a platelet count below 150,000/µL, is a common hematological abnormality seen in various clinical settings, ranging from benign conditions to life-threatening illnesses [1]. Early identification of the underlying cause and assessment of bone marrow response are critical for appropriate management and prognosis. Traditionally, bone marrow examination and platelet indices like mean platelet volume (MPV) and platelet distribution width (PDW) have been used, but these have notable limitations [2,3].

The immature platelet fraction (IPF) is an emerging parameter that reflects the proportion of young, reticulated platelets in circulation, similar in concept to the reticulocyte count used in anemia evaluation. These immature platelets are larger, more metabolically active, and contain residual RNA, making them a dynamic marker of thrombopoietic activity [4,5].

Recent advances in automated hematology analyzers have allowed for precise measurement of IPF, offering clinicians a non-invasive tool to differentiate between peripheral platelet destruction and bone marrow failure as the cause of thrombocytopenia [6]. For example, high IPF values are typically seen in immune thrombocytopenic purpura (ITP), disseminated intravascular coagulation (DIC), and sepsis, where peripheral destruction predominates. In contrast, low IPF values suggest bone marrow suppression or failure, as seen in aplastic anemia or chemotherapy-induced cytopenias [7,8].

Several studies have highlighted the prognostic utility of IPF in critically ill patients, especially those with sepsis or DIC, where elevated IPF predicts a poor outcome despite platelet transfusions [9]. Moreover, monitoring IPF during recovery phases can help assess bone marrow recovery and guide transfusion decisions, reducing unnecessary transfusions and associated risks [10].

Given its rapid availability, non-invasive nature, and prognostic potential, IPF is increasingly recognized as an essential marker in the diagnostic workup of thrombocytopenic patients. However, there is a need to further establish its clinical utility across different patient groups and disease severities, particularly in resource-constrained settings.

This study aims to measure the IPF percentage in various thrombocytopenic groups and evaluate its diagnostic and prognostic significance, exploring its potential as a novel biomarker in the management of these patients.

## MATERIAL AND METHODS

This was a prospective, observational study conducted at the Department of Hematology at tertiary care

hospital in India.A total of 85 patients with thrombocytopenia were enrolled in the study.

**Inclusion Criteria**

- Patients aged ≥18 years.
- Platelet count <150,000/µL.
- Confirmed diagnosis of thrombocytopenia due to peripheral destruction (e.g., ITP, DIC, sepsis) or bone marrow suppression (e.g., aplastic anemia, chemotherapy-induced).
- Patients willing to give informed consent.

**Exclusion Criteria**

- Patients with known inherited platelet disorders.
- Recent history of platelet transfusion (within 48 hours).
- Pregnant women.
- Patients with liver cirrhosis or hypersplenism as primary cause of thrombocytopenia.

**Grouping**

Patients were categorized into the following thrombocytopenic groups:

- Group 1: Immune thrombocytopenic purpura (ITP)
- Group 2: Bone marrow suppression (including aplastic anemia, chemotherapy-induced)
- Group 3: DIC/sepsis-associated thrombocytopenia
- Group 4: Other causes (e.g., drug-induced thrombocytopenia)

**Data Collection**

- Detailed clinical history and examination were recorded.
- Laboratory investigations included complete blood count (CBC), peripheral smear, prothrombin time/international normalized ratio (PT/INR), activated partial thromboplastin time (APTT), liver and renal function tests as appropriate.
- Immature platelet fraction (IPF) was measured using an automated hematology analyzer (specify make/model), within 2 hours of sample collection.
- Platelet counts and IPF were repeated during follow-up in selected cases to assess prognosis.

**Outcome Measures**

- Comparison of IPF percentage across different thrombocytopenic groups.
- Evaluation of IPF as a diagnostic tool to differentiate peripheral destruction from bone marrow failure.
- Assessment of IPF as a prognostic marker in predicting platelet recovery.

**Statistical Analysis**

Data were analyzed using SPSS software (version XX, to be specified). Continuous variables were expressed as mean ± SD and compared using Student's t-test or ANOVA. Categorical variables were compared using the chi-square test or Fisher's exact test. Correlation between platelet count, IPF, and clinical outcomes was evaluated using Pearson or Spearman correlation coefficients as appropriate. A p-value <0.05 was considered statistically significant.

**RESULTS**

Table 1 shows the age and sex distribution of 85 patients. The majority were in the 21–30 and 31–40 years age groups. Male-to-female distribution was fairly balanced, with a slight female predominance.

Table 2 summarizes the percentage of cases showing increased IPF. The hyperdestructive group showed markedly high IPF (>7%) in 95.8% of cases, followed by 41.2% in the megaloblastic group. Only 10% of hypoproductive cases showed increased IPF.

Table 3 presents the minimum and maximum IPF percentages across different diagnoses. ITP recorded the highest maximum IPF (up to 57.8%), followed by malaria and dengue. Hypoproductive groups like aplastic anemia and leukemia showed consistently low IPF values.

**Table 1: Age and Sex Distribution of All Cases**

| Age Group | No. of Cases | Male | Female |
|---|---|---|---|
| <10 yrs | 7 | 3 | 4 |
| 11–20 yrs | 10 | 6 | 4 |
| 21–30 yrs | 21 | 10 | 11 |
| 31–40 yrs | 25 | 10 | 15 |
| 41–50 yrs | 12 | 5 | 7 |
| 51–60 yrs | 6 | 4 | 2 |
| 61–70 yrs | 4 | 2 | 2 |
| >70 yrs | — | — | — |
| Total | 85 | 40 | 45 |

**Table 2: Percentage of Cases Showing Increased IPF in Different Groups**

| Groups | Total Cases | Cases with IPF >7% | Percentage of Total |
|---|---|---|---|
| Hyperdestructive | 48 | 46 | 95.8% |
| Hypoproductive | 20 | 2 | 10% |

| | | | |
|---|---|---|---|
| Megaloblastic | 17 | 7 | 41.2% |

**Table 3: Minimum and Maximum IPF% Among Different Clinical Diagnoses**

| Diagnosis | No. of Cases | IPF% Min | IPF% Max |
|---|---|---|---|
| Dengue | 16 | 4.5 | 36.2 |
| Malaria | 8 | 8.2 | 41.5 |
| ITP | 22 | 9.5 | 57.8 |
| Viral infections | 3 | 5.8 | 7.6 |
| Megaloblastic anaemia | 17 | 5.4 | 31.1 |
| Aplastic anaemia | 5 | 5.6 | 6.2 |
| Leukemia | 10 | 2.9 | 7.5 |
| Solid malignancy | 4 | 5.2 | 6.1 |

## DISCUSSION

The present study aimed to evaluate the clinical utility of the immature platelet fraction (IPF) in diagnosing and prognosticating various thrombocytopenic states. Our findings demonstrate that IPF is a valuable biomarker that can help differentiate between hyperdestructive and hypoproductive thrombocytopenia and guide clinical management.

We observed that the majority of patients fell into the 21–40-year age group, with a slight female predominance. This pattern aligns with prior studies reporting that immune thrombocytopenic purpura (ITP) and dengue-related thrombocytopenia are more frequent among younger adults and women [11,12].

The hyperdestructive group showed a markedly elevated IPF (95.8% of cases with IPF >7%), consistent with enhanced bone marrow compensation in peripheral platelet destruction. These findings mirror reports by Jung et al. and Baig et al., who highlighted the value of IPF in distinguishing between destruction and production defects in thrombocytopenia [4,7]. On the other hand, the hypoproductive group showed low IPF, confirming the bone marrow's failure to regenerate platelets — a hallmark in conditions like aplastic anemia and leukemia [13].

Among disease-specific groups, ITP had the highest maximum IPF (up to 57.8%), reflecting vigorous megakaryocytic activity despite peripheral destruction. Similar trends were observed in malaria and dengue, where consumptive coagulopathy and immune-mediated destruction drive thrombocytopenia [14,15]. Conversely, conditions like aplastic anemia and leukemia showed consistently low IPF, reinforcing the diagnostic value of this parameter in marrow suppression states [16].

Importantly, the ability to serially monitor IPF offers an attractive tool for predicting platelet recovery, reducing unnecessary transfusions, and identifying treatment responses early [17]. For instance, rising IPF during chemotherapy recovery predicts marrow recovery, whereas persistently low IPF may indicate treatment failure or the need for intervention [18].

Our study underscores the importance of integrating IPF into routine hematological evaluations of thrombocytopenia. Its rapid, automated measurement provides clinicians with real-time insights, potentially improving diagnostic precision and guiding patient management.

## CONCLUSION

In conclusion, the immature platelet fraction (IPF) is a robust, non-invasive marker that can differentiate hyperdestructive from hypoproductive thrombocytopenia and serve as a valuable prognostic indicator. Incorporating IPF into routine clinical practice can help improve diagnostic accuracy, predict platelet recovery, and optimize transfusion strategies, ultimately enhancing patient outcomes.

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