International Journal of Medicine
pISSN 1468-3814 | eISSN 2667-7008
https://theinternationalmedicine.com/

*Original Researcher Article* *DOI: 10.61336/im/26-07-13*

# Evaluation of Platelet-Large Cell Ratio (P-LCR) in Patients with Abnormal Platelet Counts: A Hospital-Based Observational Cross-Sectional Study.

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**Received:** 26-05-2026
**Revised:** 09-06-2026
**Accepted:** 22-06-2026
**Published:** 02-07-2026

## Abstract

***Background:*** Platelet indices, particularly the platelet-large cell ratio (P-LCR), provide insights into platelet size, production, and turnover beyond simple platelet counts. P-LCR may help differentiate hypoproductive from hyperdestructive thrombocytopenia and assess thrombocytosis, offering a non-invasive, cost-effective adjunct to bone marrow examination. ***Objectives:*** To evaluate P-LCR in patients with abnormal platelet counts, establish its variation in thrombocytopenia and thrombocytosis, assess correlations with other platelet indices, and determine its diagnostic utility in distinguishing hypoproductive from hyperdestructive thrombocytopenia. ***Methods:*** This hospital-based observational cross-sectional study was conducted at the Central Clinical Laboratory, Pathology Department, Santosh Hospital, Ghaziabad, from January 2024 to December 2025. A total of 149 adult patients with documented abnormal platelet counts were included using stratified random sampling. Platelet indices (P-LCR, MPV, PDW, PCT) were measured using an automated hematology analyzer (impedance method). Bone marrow findings were available for 60 patients. Data were analyzed using SPSS version 25 with t-tests, Chi-square, Pearson correlation, and ROC curve analysis. ***Results:*** Thrombocytopenia was present in 123 patients (82.55%) and thrombocytosis in 26 (17.46%). Mean P-LCR was significantly higher in thrombocytopenia (36.5 ± 7.4%) than thrombocytosis (25.2 ± 6.1%) ($p < 0.001$). P-LCR showed strong positive correlation with MPV ($r = +0.812$) and PDW ($r = +0.769$), and negative correlation with platelet count ($r = -0.684$). At a cut-off >36.5%, P-LCR had sensitivity 87.2%, specificity 82.4%, and AUC 0.902 for differentiating hyperdestructive from hypoproductive thrombocytopenia. Bone marrow findings correlated significantly with P-LCR categories ($p < 0.001$). ***Conclusion:*** P-LCR is a reliable, non-invasive marker that aids in differentiating causes of thrombocytopenia and provides valuable information on platelet dynamics. Its routine use alongside other indices can guide clinical decisions and reduce the need for invasive procedures.

**Keywords:** Platelet-large cell ratio, Thrombocytopenia, Thrombocytosis, Platelet indices, Hypoproductive, Hyperdestructive, Diagnostic accuracy.



## INTRODUCTION

Platelets are anuclear fragments of megakaryocytes essential for hemostasis. Thrombocytopenia (<150 × $10^9$/L) results from decreased production, increased destruction, or sequestration. Thrombocytosis may be primary (bone marrow proliferation) or secondary (inflammation, iron deficiency). While platelet count provides quantitative data, automated analyzers yield indices such as mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT), and platelet-large cell ratio (P-LCR) that reflect platelet size, heterogeneity, and turnover.

P-LCR represents the proportion of platelets with volume >12 fL and correlates positively with MPV and PDW while correlating negatively with platelet count. Elevated P-LCR indicates increased large, immature platelets from compensatory thrombopoiesis in peripheral destruction (e.g., immune thrombocytopenia, DIC). Lower values suggest impaired production (e.g., aplastic anemia, chemotherapy). Platelet heterogeneity arises from megakaryocyte ploidy, platelet aging, and turnover. Large platelets are more metabolically active.

Bone marrow biopsy is definitive but invasive. P-LCR offers a safe, inexpensive alternative. Despite promise, standardization and normative data remain limited. Recent studies show utility in differentiating thrombocytopenia causes and assessing thrombotic risk. This study evaluates P-LCR in abnormal platelet counts, compares groups, assesses correlations, and determines diagnostic accuracy for hypoproductive versus hyperdestructive thrombocytopenia.

## MATERIALS AND METHODS

**Study Design and Setting:** Hospital-based observational cross-sectional study at Central Clinical Laboratory, Pathology Department, Santosh Hospital, Ghaziabad.

**Duration:** 1 January 2024 to 31 December 2025.

**Sample Size:** 149 patients (calculated with Z=1.96, P=54%, D=8% from prior study).

**Inclusion Criteria:** Adults ≥18 years with abnormal platelet counts on recent CBC and informed consent.

**Exclusion Criteria:** Normal platelet counts at enrollment, pregnancy/breastfeeding, or refusal of consent.

**Sampling:** Stratified random sampling by abnormality type (thrombocytopenia vs thrombocytosis).

**Procedure:** Venous blood collected in EDTA tubes aseptically. Platelet indices measured by automated analyzer (impedance method). Data collected via standardized forms including demographics, diagnosis, and bone marrow findings (where available).

**Statistical Analysis:** SPSS version 25. Continuous variables as mean ± SD; categorical as frequencies/percentages. Independent t-test and Chi-square for comparisons. Pearson correlation for associations. ROC curve for diagnostic performance of P-LCR. $p<0.05$ significant.

**Ethical Considerations:** Informed consent obtained; institutional ethics approval secured.

## RESULTS

The study included 149 patients (mean age 42.6 ± 13.2 years, range 18-75). Thrombocytopenia predominated (82.55%).

**Table 1. Age-Wise Distribution of Study Population**

| Age Group (years) | Number of Patients | Percentage (%) | Mean P-LCR (%) ± SD |
|---|---|---|---|
| 18 – 30 | 46 | 30.9 | 37.8 ± 8.4 |
| 31 – 45 | 43 | 28.9 | 35.4 ± 7.6 |
| 46 – 60 | 36 | 24.2 | 31.2 ± 6.5 |
| > 60 | 24 | 16.0 | 27.5 ± 5.9 |
| Total | 149 | 100 | — |
| Mean ± SD | — | — | 42.6 ± 13.2 |

P-LCR declined progressively with age.

**Table 2. Type of Platelet Abnormality**

| Type of Abnormality | Number (n) | Percentage (%) |
|---|---|---|
| Thrombocytopenia | 123 | 82.55 |
| Thrombocytosis | 26 | 17.46 |
| Total | 149 | 100 |

Thrombocytopenia was nearly five times more common.

**Table 3. Platelet Count and Indices Comparison Between Groups**

| Parameter | Thrombocytopenia (n=123) Mean ± SD | Thrombocytosis (n=26) Mean ± SD | p-value |
|---|---|---|---|
| Platelet Count (×10⁹/L) | 78.6 ± 24.3 | 634.2 ± 118.7 | <0.001 |
| MPV (fL) | 10.8 ± 1.6 | 8.3 ± 1.2 | <0.001 (HS) |
| PDW (%) | 16.7 ± 2.5 | 13.4 ± 1.8 | <0.001 (HS) |
| P-LCR (%) | 36.5 ± 7.4 | 25.2 ± 6.1 | <0.001 (HS) |
| PCT (%) | 0.09 ± 0.03 | 0.53 ± 0.11 | <0.001 (HS) |

All indices differed significantly; higher MPV, PDW, and P-LCR in thrombocytopenia indicated compensatory large platelet release.

**Table 4. Correlation of P-LCR With Other Platelet Indices**

| Variable | Correlation Coefficient (r) | p-value |
|---|---|---|
| MPV | +0.812 | <0.001 |
| PDW | +0.769 | <0.001 |
| Platelet Count | −0.684 | <0.001 |
| PCT | −0.321 | 0.002 |

Strong positive correlations with size/variability indices; negative with count and mass.

**Table 5. Diagnostic Accuracy of P-LCR for Differentiating Hypoproductive vs Hyperdestructive Thrombocytopenia**

| Parameter | Cut-off Value (%) | Sensitivity (%) | Specificity (%) | PPV (%) | NPV (%) | AUC (95% CI) | p-value |
|---|---|---|---|---|---|---|---|
| P-LCR | >36.5 | 87.2 | 82.4 | 84.5 | 85.3 | 0.902 (0.851–0.954) | <0.001 |

Excellent discriminative ability at >36.5% cut-off.

## DISCUSSION

The present cross-sectional study of 149 patients demonstrated that P-LCR is a valuable, non-invasive marker for evaluating platelet dynamics in abnormal counts. Thrombocytopenia predominated (82.55%), consistent with Nathan et al. (2024)1, who studied 80 thrombocytopenic patients and noted higher MPV in hyperdestructive cases without significant gender differences. Our male predominance (56.4%) and lack of significant sex-based differences in indices align with their findings and those of Parray et al. (2021)2 and Baig et al. (2015)3.

Mean P-LCR was significantly higher in thrombocytopenia (36.5 ± 7.4%) than thrombocytosis (25.2 ± 6.1%) ($p<0.001$), mirroring Babu et al. (2004)4, who reported elevated P-LCR in thrombocytopenia versus reduction in thrombocytosis. Reddy et al. (2018)5 found mean P-LCR 31.68 ± 8.36% in accelerated destruction versus 19.50 ± 5.51% in impaired production, closely matching our hyperdestructive pattern and supporting compensatory release of large immature platelets. Strong positive correlations of P-LCR with MPV ($r=+0.812$) and PDW ($r=+0.769$) and negative with platelet count ($r=-0.684$) confirm increased size heterogeneity during low counts, consistent with Baig et al. (2015)3 and Nadeem et al. (2022)6, who reported similar inverse relationships and higher indices in non-survivors.

Bone marrow correlation showed hypocellular marrow linked to low P-LCR (72.7%) and hypercellular/megaloblastic to high P-LCR, aligning with Hamed et al. (2021)7 (elevated indices in megaloblastic thrombocytopenia) and Parray et al. (2021)2. This reinforces P-LCR as a reflector of marrow activity.

Diagnostic performance at >36.5% cut-off (sensitivity 87.2%, specificity 82.4%, AUC 0.902) exceeds or matches recent reports: Tameemi et al. (2022)8 noted 100% P-LCR sensitivity for ITP; Chen et al. (2022)9,10 identified P-LCR as independent prognostic factor in MDS. Saran et al. (2022)11 and Francis et al. (2021)12 highlighted higher indices in hyperdestructive thrombocytopenia, supporting our ROC findings.

Compared to older studies like Grotto et al. (2004)13 and Wysokiński et al. (2016)14, our results extend utility to mixed thrombocytopenia/thrombocytosis cohorts with modern analyzer data. Limitations include single-center design and partial bone marrow correlation. Strengths are prospective sampling, standardized methods, and comprehensive correlation/ROC analysis.

P-LCR complements MPV/PDW for differentiating destruction from production defects, guiding decisions on marrow examination and monitoring therapy response, as noted across cited literature.

## CONCLUSION

P-LCR is a reliable, accessible platelet index that differentiates hypoproductive from hyperdestructive thrombocytopenia with high accuracy and correlates strongly with other indices and marrow findings. Routine inclusion in CBC interpretation enhances diagnostic precision, reduces invasive testing, and aids management of platelet disorders.

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