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Study of Platelet Indices and their Role in Evaluation of Thrombocytopenia

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Abstract

Platelets are essential components of the hemostatic system, playing a key role in blood clotting and vascular integrity. Their function and morphology can be assessed through platelet indices, including Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), and Platelet Large Cell Ratio (P-LCR). These indices provide insight into platelet production, activation, and turnover, making them valuable markers in the evaluation of thrombocytopenia. Thrombocytopenia, defined as a platelet count below 150,000/μL, can result from various mechanisms, including: 1. Decreased platelet production – due to bone marrow disorders (e.g., aplastic anemia, leukemia, myelodysplastic syndromes). 2. Increased platelet destruction – commonly seen in immune thrombocytopenia (ITP), disseminated intravascular coagulation (DIC), or drug-induced thrombocytopenia. 3. Increased platelet sequestration – occurring in hypersplenism, typically due to liver disease or splenic disorders.

Methodology

A hospital based cross-sectional study was carried out in Central Laboratory, Department of pathology Sree Balaji Medical College and Hospital, between the period of Study of platelet indices and their role in evaluation" Is a cross sectional study Material of the study will be obtained from the blood samples received in the Hematology lab, Department of Pathology, SBMCH, Chrompet, Chennai over a period of 6 months from March to August. Relevant clinical details will be ready from request forms.

Introduction

A study done by Khushboo Saran, Vidya K, KumariSeema, Anupa Prasad, Jay Prakashsin the year 2022 on the topic Study of platelet indices and their role in evaluation of thrombocytopenia" concludes that .Platelet indices such as MPV, PCT, and PDW are significantly higher in hyper-destructive causes of thrombocytopenia and may discriminate hyper-destructive from hypo-productive causes of thrombocytopenia. In the majority of patients, it may help in delaying or avoiding unnecessary, invasive bone marrow examination. MPV stands as a better parameter, which is statistically significant and can be used to segregate the hyper-destructive and hypo-productive causes of thrombocytopenia. 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 probablepathophysiology of thrombocytopenia [1].

•A study done by Omer Noureldaim Abdalla, Tagwa Yousif Elsayed, Hisham Waggiallah in the year 2016 on the topic "significance of platelet count and platelet with some Thrombocytopenic conditions" concludesthat In thrombocytopenic conditions the PVI has the ability to change from normal range to either higher or lower than healthy sudanesepopulation. Sudanese population has PVI mean lower than the mean of reference range chinese Han population, and Brazillian population in tha detectable inverse and reverse between PLT count and PVI in thrombocytopenic conditions.but not in healthy Sudanese population There is reverse correlation in between PVI except between PDW and P- LCR in hypoplastic bone marrow. Detection of what has Being called "the interchangeable value" (shared PVI values Between the Study population) "the X-value" (unexpressed Pattern discriminator value of PVI in thrombocytopenic Conditions), and induction of "the X-protocol" (multiple blood Conditions), and induction of "the X-protocol" (multiple blood sampling) [2].

•A study done by Tejaswi Peddaverannagari, Nalinimohan Chakkirala, Shailaja Prabhala, Ashokkumar Deshpande. In the year of 2020 on the topic "Utility of Platelet Count and Platelet Indices In the Evaluation of Thrombocytopenia" concludes that Platelet indices such as MPV, PDW show prominent increase In hyperdestructive type of thrombocytopenia and are accompanied usually by markedly low platelet counts, Whereas, hypoproductive thrombocytopenia does not show marked increase in MPV or PDW and usually does not have Severe thrombocytopenia The plateletcrit does not show Any variation in either of the thrombocytopenias Platelet Indices provide useful preliminary information about the typeof thrombocytopenia even before bone marrow reports arrive. Also they neither need additional blood sample or Additional time and donor incur any extra expense as they Can be performed during routine blood cell counting [3].

•A study done by Dr. Shashwat Vidyadhar MBBS, MD (Pathology) Assistant Professor, Department of Pathology, Career Institute of Medical Sciences & hospital, Lucknow, U.P Corresponding Author: Dr.Shashwat. In the year 2019 on the topic Diagnostic Implication and Utility of Platelet Indices in Differentiating Hypoproductive and hypoproductive Thrombocytopenia concludes that During evaluation of thrombocytopenic patients, it is essential to identify the etiology, whether it is due To hypoproduction or hyperdestruction which will have impact on the management.Mean platelet volume may Provide useful information in discriminating the hypoproductive and hyperdestructive thrombocytopenia. MPV is an accurate,reliable & easily obtained platelet parameter which is helpful in diagnosing the basic etiology of Thrombocytopenia.Platelet indices show inverse relationship with platelet count as they are increased in Hyperdestructive type & show linear relationship in hypoproductive type [4].

•A Study done by Vani Mittal, Munesh, Irbinder Kour Bali, Sunil Arora, Jyoti Singh, Mohit Dadu. In the year 2021 on the topic "Study of Platelet Indices and Their Interpretation in Thrombocytopenia as concludes that a Tertiary Care Hospital" concludes that Platelet crit can help assess both quantitative as well as Qualitative platelet disorders and there is direct relation between PCT and platelet count. Other parameters like PDW, PLCR and MPV along with PCT can be used to interpret the mechanism behind the low platelet count, where high values of indices indicate increased breakdown of platelets in the bloodstream and low values are possibly due to impaired Production due to primary or secondary bone marrow Disease. These parameters need

to be studied more, as their Significance if recorded [5].

Methods and Materials

Study of platelet indices and their role in evaluation" Is a cross sectional study Material of the study will be obtained from the blood samples received in the Hematology lab, Department of Pathology, SBMCH, Chrompet, Chennai over a period of 6 months from March to August. Relevant clinical details will be taken from request forms.

Study Design: Cross Sectional Study

Inclusion Criteria

•Patients aged 18 years and above with documented thrombocytopenia (platelet count <150,000/μL).

•Patients presenting with unexplained thrombocytopenia for further evaluation.

•Patients diagnosed with infectious, hematological, or systemic disorders known to affect platelet indices.

Exclusion Criteria

• Inadequate/Rejected blood sample.

• Patient refused consent.

Sample Collection: Patient History Blood Samples (EDTA Vacutainer)

Result

The collected data were entered in the Microsoft Excel 2016 and analysed with IBM SPSS Statistics for Windows, Version 29.0.(Armonk, NY: IBM Corp).To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Independent groups the Independent sample t-test was used. To find the significance in qualitative categorical data Chi-Square test was used. In all the above statistical tools the probability value .05 is considered as significant level.

Table 1: Age Distribution

Age Distribution		
	Frequency	Percent
Up to 20 yrs	7	8.8
21-40 yrs	20	25
41-60 yrs	22	27.4
61-80 yrs	31	38.8
Total	80	100

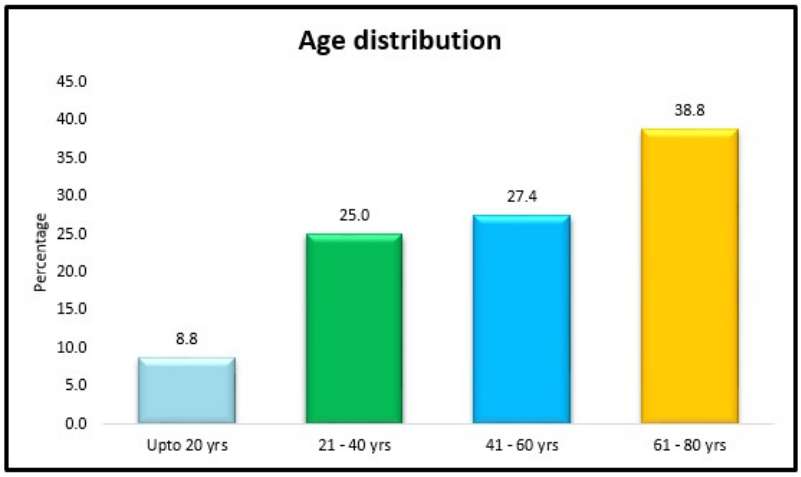

Figure 1: The Above Table Shows Age Distribution Where up to 20 Yrs Is 8.8%, 21 – 40 Yrs Is 25.0%, 41 – 60 Yrs Is 27.5%, 61 – 80 Yrs Is 38.8% of Study Population.

Table 2: Gender distribution.

Gender Distribution		
	Frequency	percent
Female	40	50
Male	40	50
Total	80	100

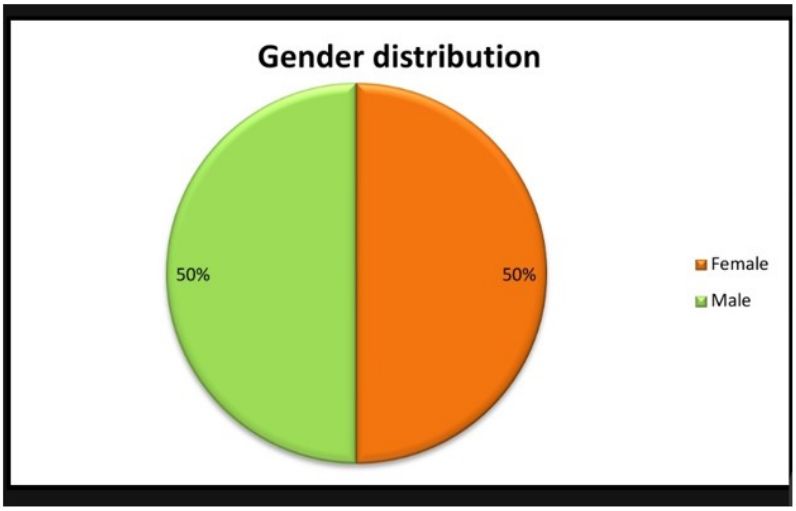

Figure 2: The above table shows Gender distribution where Female is 50.0%, Male is 50.0% of study population.

Discussion

Thrombocytopenia arises from decreased production, increased destruction, or sequestration, with platelet indices like MPV, PDW, and P-LCR reflecting compensatory bone marrow responses. In hyperdestructive states such as ITP, elevated MPV (often >10 fL) and PDW indicate release of larger, reticulated platelets, contrasting with lower values in hypoproductive conditions like aplastic anemia or leukemia. These patterns align with peripheral smear findings of giant platelets in destructive thrombocytopenia, supporting indices as surrogate markers for megakaryocytic activity.

Multiple studies consistently report statistically significant differences: MPV (11.6 ± 2.25 fL), PDW (15.16 ± 1.36 fL), and P-LCR (34.30 ± 2.2%) higher in hyperdestructive versus hypoproductive groups (MPV 8.5 ± 1.27 fL, PDW 14.10 ± 1.15 fL). P-LCR cutoffs>33.6% yield 95% sensitivity for ITP, while IPF aids severity assessment, though platelet count and PCT show less discriminatory power .These align with prior research by reinforcing reliability across pediatric and adult cohorts.

Routine integration of indices into CBC reduces unnecessary bone marrow biopsies, guides therapies (e.g., steroids for ITP, transfusions for hypoproduction), and predicts bleeding risk, with low MPV signaling higher hemorrhage potential. Limitations include analyzer variability, pseudo thrombocytopenia, and group overlaps, necessitating smear correlation and clinical context. Future standardization could elevate their prognostic role in hematological practice.

Conclusion

Platelet indices such as MPV, PDW, and P-LCR effectively differentiate hyperdestructive from hypoproductive thrombocytopenia, demonstrating elevated values in conditions like ITP that reflect bone marrow compensation, while lower indices signal production defects in aplastic anemia or leukemia . Age influences these patterns with declining platelet counts and rising index variability in the elderly, gender shows women with higher baseline counts alongside nuanced index differences, and severity stratification by platelet count (<50,000/μLindicating high risk) enhances prognostic utility across groups . Overall, routine incorporation into CBC analysis offers a cost-effective, non-invasive diagnostic aid that reduces reliance on bone marrow biopsies when correlated with clinical and smear findings, though analyzer variability and overlaps warrant age/gender-specific reference ranges for optimal accuracy.

In this study Platelet indices prove highly valuable in thrombocytopenia evaluation, consistently showing elevated MPV (>10-11 fL), PDW (>15%), and P-LCR (>33%) in hyperdestructiveetiologies like ITP due to compensatory release of larger reticulated platelets from marrow hyperactivity, in stark contrast to suppressed indices (MPV <9 fL) in hypoproductive states such as aplastic anemia, chemotherapy, or leukemia where megakaryocyte failure predominates . Age stratification reveals pediatric patients exhibiting more pronounced index elevations in immune-mediated cases, middle-aged adults displaying peak PDW variability amid lowest baseline PLT, and elderly cohorts (>60 years) with naturally declined PLT (down ~22% vs. youth) yet heightened heterogeneity, all necessitating tailored cutoffs to avoid misdiagnosis . Gender patterns further refine utility, as women maintain higher PLT (~233 vs. 197×10^9/L in men) with subtly lower MPV but comparable PDW/PCT responses, influencing ITP detection where female baselines amplify discriminatory power. Severity grading by PLT—mild (100-150k), moderate (50-99k), severe (<50k, critical <20k)—correlates inversely with indices in destructive thrombocytopenia, predicting bleeding risk (low MPV signals higher hemorrhage) and guiding interventions like steroids over transfusions . Despite overlaps and analyzer inconsistencies, these automated CBC parameters deliver cost-effective, non-invasive insights that minimize bone marrow aspirations, with statistical significance across studies.

Acknowledgment

At this juncture I would like express my sincere gratitude to the Department of pathology, Sree Balaji Medical College and Hospital for their valuable guidance, cooperation and support throughout the course of this study and sincere thanks to all the patients participated in this study.

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