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A Study of Platelet Large Cell Ratio [P-LCR] in Thrombocytopenia

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Abstract: Thrombocytopenia is a group of heterogeneous disorders of varying etiology and involving deficiency of platelets. Platelet volume parameters are significant especially in the diagnosis of causes of thrombocytopenia. The platelet volume parameters have been widely available as part of full blood count profile on automated hematology analyzers. To evaluate the relationship between platelet volume parameters and causative process in thrombocytopenia Methods: PLCR of 500 cases of thrombocytopenia (TCP) and 300 control cases having normal platelet counts were recorded. The analysis was done by Sysmex KX 21 cell counter and every case was reassessed by Peripheral Smear (P.S.) examination and if necessary also by the manual method. Only those cases that had sufficient clinico-hematological work up were included in the study. Results: Cases were grouped according to the most predominant mechanism of Group A-Accelerated platelet destruction, Group B-Impaired platelet production, and Group C-Abnormal platelet pooling. The age range was from 1 day to 90 years. The commonest age group for thrombocytopenia was between 21-30 years accounting for 88(18%) cases. 75(15%) cases belonged to both 31-40 and 41-50 age groups. The mean platelet large cell ratio P-LCR % was 22.64 ± 7.13 and in Group A it was 31.68 ± 8.36 and in Group B was 19.50 ± 5.51 and Group C was 31.48 ± 9.09. The Z test was performed between A, B and C Group with the control group of all the parameters of the platelet count. The P-LCR of accelerated destruction Group A, B, C and Vs Control were all significant values <0.05. Conclusion: Platelet Large cell ratio and the Platelet distribution width showed a direct linear relationship in all groups of Thrombocytopenia as well as the control group. Decreased production of platelets in cases of thrombocytopenia can be differentiated from other two groups of thrombocytopenia with the help of all the three parameters MPV, PDW and P-LCR as the differences are statistically significant.

Keywords: Platelet Large Cell Ratio [P-LCR], Thrombocytopenia.

INTRODUCTION

Thrombocytopenia (TCP) is not a disease entity by itself, but a finding that may result from a number of disease processes. By definition, there are subnormal numbers of platelets in circulating blood and it is one of the most common causes of abnormal bleeding [1]. P-LCR is the ratio of a number of platelets between 12fl and the upper discriminator to total platelet count [2]. This ratio provides the variation of which may be used to identify the presence of large platelets. P-LCR varies inversely with platelet count and correlates directly with PDW and MPV [3]. In 1969, S. Karpatkin observed heterogeneity of human platelets. Di-isopropyl fluorophosphate (DFP) survival curves in rabbits indicate that large heavy platelets have a greater metabolic potential and suggests that they may be young platelets which progress with age to light-small platelets with diminished metabolic potential [4]. Results of studies of size-specific platelet cohorts suggest that, at least in some species, the largest platelets are youngest members of the population and large platelets are considered to be more functionally active than small platelets [4, 5]. If this observation is correct, platelets must diminish in size during their sojourn in the circulating blood; that is heterogeneity of platelet size is acquired as the result of platelet aging. Furthermore, small pieces of platelet membrane and small amounts of cytoplasm are shed progressively in the general circulation, possibly as the result of reversible hemostatic encounters. Platelet buoyant density rather than mean platelet volume correlates more reliably with platelet age.

It is uncertain whether platelets of different sizes and densities originate from different populations of megakaryocytes [6, 7]. In one study, small platelets originated from 32N megakaryocytes had a low density, presumably because of an over abundant surface-connected canalicular system [7]. 8N megakaryocytes produced large heavy platelets, which contain a disproportionate number of mitochondria, dense bodies, and alpha granules [7]. Other investigators suggest that

only the organelle content of platelets is regulated by the ploidy class of megakaryocyte [8]. Both intrinsic and acquired heterogeneity may determine the size of circulating platelets; for example heterogeneity that develops during aging in the circulation is superimposed on that intrinsic to the cell line [9]. Or that resulting from accelerated platelet production or increased ploidy class of the precursor cell [8]. Finally many of the properties of large platelets may reflect unique attributes of platelets or pro-platelets [10]. Produced under conditions of accelerated production [11]. In any case, changes in the relative number of large platelets have proved clinically useful and may explain reports of altered platelet biochemistry or function under various disorders associated with subnormal or accelerated removal [1, 12]. With this background we in the present study tried to evaluate the Platelet Large Cell Ratio [P-LCR] to the total platelet counts in thrombocytopenia patients compared with control.

MATERIALS AND METHODS

This prospective study was carried out in the Department of Pathology, ASRAM Medical College and Hospital, Eluru and Rajiv Gandhi Institute of Medical Sciences, Adilabad. Both are teaching Institutes mainly catering the rural population of Andhra Pradesh and Telangana respectively. Institutional Ethical committee permission was obtained in both the Institutes. 500 thrombocytopenia (TCP) cases were studied and a control group of 300 cases having a normal count of red blood corpuscles (RBC), White Blood Corpuscles (WBC) and platelets were also included. TCP was defined as platelet count less than 1.5 lakhs/µl. Blood was collected in K-EDTA bulb and analysis was done by the system KX- 21 (Sysmex corporation Japan 1998) automated hematology analyzer, within 2- 6 hours of collection. Platelet count and platelet volume parameters if displayed, of all the 800 samples (including 300 samples of the control group) were noted. Every case of TCP was reassessed by P.S. examination and if necessary also by the manual method. Cases with a discrepancy in counts by different methods were excluded from the study. Only the cases that had sufficient clinico-hematological work-up were included in the study and the data was analyzed by graphical and statistical methods using SPSS Version 17 Software.

RESULTS

In the present study 500 cases of thrombocytopenia and their clinical features, platelet count and platelet volume parameters were studied. Cases were grouped according to a predominant mechanism of thrombocytopenia, Group A-Accelerated platelet destruction, Group B-Impaired platelet production and Group C-Abnormal platelet pooling. Majority of the cases belong to group A (80%), suggesting the mechanism of accelerated destruction. The age range was from 1 day to 90 years. The commonest age group for thrombocytopenia was between 21-30 years accounting for 88(18%) cases. 75(15%) cases belonged to both 31-40 and 41-50 age groups. 272 (54%) were male and 228(46%) were female with the male to female ratio as 1.19:1. A slight male preponderance was seen in the overall picture as well as in almost all age groups.

Table-1: Distribution of cases according to the predominant mechanism of thrombocytopenia

Sl. No	Accelerated Platelet Destruction Group 'A' [80%]	Impaired Platelet Production Group 'B' [12%]	Abnormal Platelet Pooling Group 'C' [8%]
1.	Infections Bacterial -118 (24%) Viral - 83(14%) Malaria -71(17%) Enteric fever-18 ((4%)	Iron deficiency anemia & Megaloblastic anemia - 27 (5%)	Congestive splenomegaly – 42 (8%)
2.	Pregnancy – 21(4%)	Acute leukemia, MDS - 20(4%)	
3.	Neonatal causes -19(4%)	Aplastic anemia-7(1%)	
4.	Renal diseases- 16(3%)	Chemotherapy- 7(1%)	
5.	Blood transfusion- 12(2%)		
6.	Shock (Post partum, Post MI) - 8(2%)		
7.	ITP - 7(1%)		
8.	Snake bite - 7(1%)		
9.	Miscellaneous -18 (4%)		
	TOTAL	500 CASES	

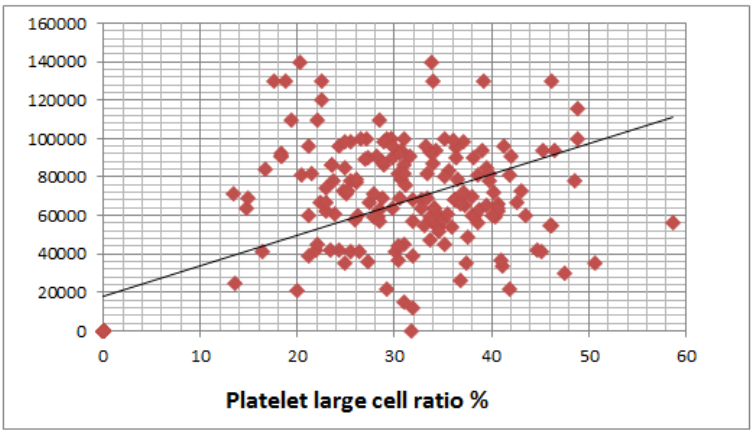

Fig-1: Platelet Large Cell Ratio [P-LCR] in Group A patients

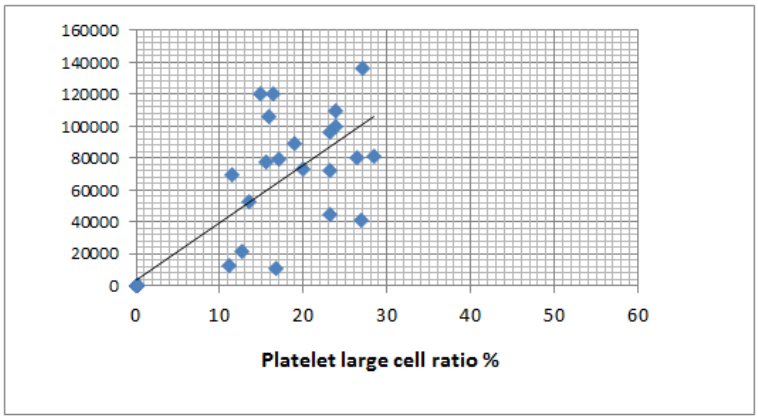

Fig-2: Platelet Large Cell Ratio [P-LCR] in Group B patients

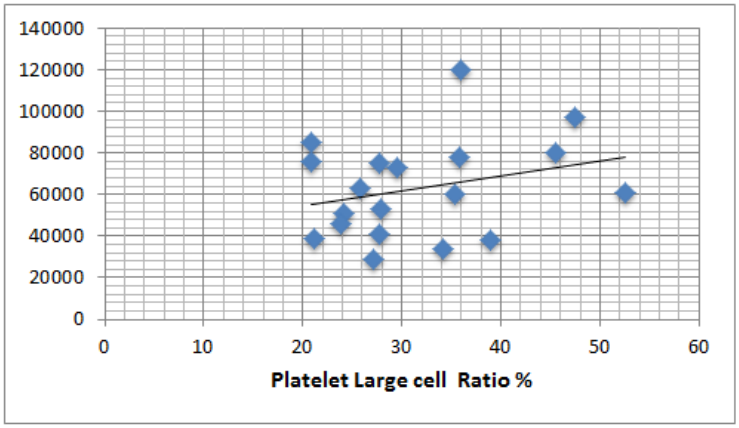

Fig-3: Platelet Large cell Ratio [P-LCR] in Group C patients

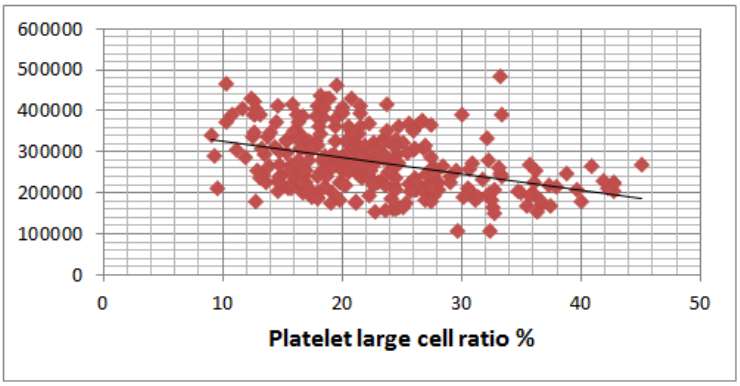

Fig-4: Platelet Large Cell Ratio [P-LCR] in Control patients

Table 2 shows the comparison of different platelet parameters with the control group. The mean platelet large cell ratio P-LCR % was 22.64 ± 7.13 and in Group A it was 31.68 ± 8.36 and in Group B was 19.50 ± 5.51 and abnormal pooling it was 31.48 ± 9.09.

Table-2: comparison of platelet volume parameters (mean) with control

Platelet indices	Control group	Accelerated destruction	Impaired production	Abnormal pooling
MPV (fl,mean±SD)	*9.55±0.97*	*10.59±1.24*	*8.37±0.96*	*10.41±1.36*
PDW (fl,mean±SD)	*12.12±1.99*	*16.06±3.65*	*12.15±2.93*	*16.61±4.22*
P-LCR(%,mean±SD)	*22.64±7.13*	*31.68±8.36*	*19.50±5.51*	*31.48±9.09*

The Z test was performed between A, B and C Group with the control group of all the parameters of the platelet count. The P-LCR of accelerated destruction Group A, B, C and Vs control were all significant values <0.05.

Table-3: `Z test' for Statistical Comparison of platelet volume parameters with control

	Accelerated destruction vs Control	Impaired production vs Control	Abnormal pooling vs Control
MPV	*Z = 9.5(p < 0.001)*	*Z = 5.61(p <0.001)*	*Z = 2.84 (p <0.002)*
PDW	*Z = 13.13 (p <0.001)*	*Z = 0.04 (p <0.48)* ^{NS}	*Z = 4.83 (p <0.001)*
P-LCR	*Z = 11.94 (p <0.001)*	*Z = 2.53 (p<0.05)*	*Z = 4.37 (p <0.001)*

Note: All values < 0.05 are significant

DISCUSSION

Thrombocytopenia (TCP) can be due to increased peripheral destruction, inadequate production or abnormal pooling. Clinical methods alone do not always permit a confident assessment of mechanism in individual cases. Platelet volume parameters are the measurements made on peripheral blood platelets and include MPV, PDW, and P-LCR. P-LCR is an indicator of the fraction of platelets which are large in size (>12fl). In the present study, we found P-LCR when compared with the different groups the values was found to be significant. In 1980's Tomita E compared platelet volume by use of peak platelet volume (PPV), Mean platelet volume (MPV) and percent of large platelets (PLP) as parameters of the platelet volume and studied relationship between the platelet volume and specific gravity of platelets in children and observed that the three parameters provide good weapon for early differential diagnosis of acute ITP, chronic ITP, and aplastic anemia [13]. In 1999, Andreas G Niethmmer and Edwin N Forman recommend the use of the maximum of the histogram than MPV and is the highly effective test for the evaluation of thrombocytopenia [12].

Table-4: Comparison of the present study with the previous study

Studies P-LCR (mean±SD)	Control group	Accelerated Destruction	Impaired Production	Abnormal pooling
E Babu, D Basu [3]	23.6±7.4	29.5±7.9	27.4±5.8	------
Sangeeta Borkataky *et al*. [18]	31.49±9.77	28.84±11.77	Megalo 33.88±10.52, Non Megalo 22.40±9.77	------
Present Study	22.64±7.13	31.68±8.36	19.50±5.51	31.48±9.09

Although we studied 500 cases of TCP, platelet parameters were given by cell counter in 216 cases. Analysis of the parameters was done in these 216 cases that constituted 43% of all. In control group, the same parameters were given in all 300 cases. In 284 (57%) cases the platelet parameters were not given by the cell counter. The same limitation has been quoted in some other studies [15, 16]. Ken Kaito *et al.* quoted that it is not possible to record platelet indices in severe TCP, and in presence of red cell fragmentation, a platelet histogram cannot be adequately drawn, and the indices cannot be recorded [17]. E Babu *et al*. found the mean platelet P-LCR in control group to be 23.6 ± 7.4 and they concluded that Platelet Large Cell Ratio if properly utilized can be a good aid in the differential diagnosis of conditions associated with abnormal platelet counts [3]. Sangeeta B *et al*. found P-LCR of Control group was 31.49 ± 9.77 in the present study the values in control group was 22.64 ± 7.13 given in table 4. In 2010 Mansour Hussein *et al*. studied platelet indices in dromedary camels and found a highly significant correlation between PLT and PCT and significant correlation between MPV and PDW. [18] We in the present study found a significant relationship between thrombocytopenia groups and control group with respect to platelet large cell ratio [P-LCR].

CONCLUSION

Platelet Large cell ratio and the Platelet distribution width showed a direct linear relationship in all groups of Thrombocytopenia as well as the control group. Decreased production of platelets in cases of thrombocytopenia can be differentiated from other two groups of thrombocytopenia with the help of all the three parameters MPV, PDW and P-LCR as the differences are statistically significant.

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