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SIGNIFICANCE OF PLATELET COUNT AND PLATELET INDICES IN PATIENTS WITH SOME THROMBOCYTOPENIC CONDITIONS

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ABSTRACT

Background: Thrombocytopenia is one of the most frequent causes for hematologic consultation in the practice of medicine and can result from a wide variety of conditions. **Objective**: The study was conducted on behave of platelets count in tie with platelet volume indices to measure their consistency. **Methods**: The study was "prospective cross-sectional hospital based design" and conducted at Khartoum hospitals (A.Gasim, Jafar I A, and R.ICK). Studied populations texture has stipulated concurred diagnosis of heart disorders (HD), lymphoid neoplasms (LN), hypoplastic bone marrow (HPB), renal transplantation (RT), patients under chemotherapy (CT), and fully checked healthy Sudanese population (HSP). Platelet (PLT) count and platelet volume index (PVI) were measured using automated method of Sysmex KX-21N and the data was analyzed using SPSS. **Results:** does established (24) mean and standard for the study population among which (HSP) was platelet distribution width (PDW) (11.4±1.5 fl), mean platelet volume (MPV) (9.3±0.8 fl), platelet large cell ratio (P-LCR) (20.6±6.7%) and PLT count (245±45 X109/L), and established correlations between PLT count and PVI in thrombocytopenic conditions. **Conclusion:** we conclude that, PVI has the ability to change from normal to higher or lower than (HSP) in thrombocytopenic conditions and Sudanese has PVI mean lower than the mean of reference range, and there are inverse and reverse correlations between PLT count and PVI but not in (HSP) and reverse correlation in between PVI except between PDW and P-LCR in (HPB)

Keywords: PLT count, PVI, MPV, P-LCR, Thrombocytopenic conditions

INTRODUCTION

Thrombocytopenia is one of the most frequent causes for hematologic consultation in the practice of medicine and can result from a wide variety of conditions. This would make large magnitude for its incidence. In Khartoum state, more than (7500) patients[1] received chemotherapy in the year (2103) in Radiation & isotopes Centre Khartoum. The international incidence of immune thrombotic purpura (ITP) is (5.5) per (100,000) persons,[2] ITP is responsible for (4 to 5) percent of all cases of pregnancy-associated thrombocytopenia. Adding up thrombocytopenia can produce severe morbidity and mortality [3] due to intensive bleeding to major organ or intra cerebral bleeding[4]. This study tries to highlights the importance of non-invasive, inexpensive test, aiming to measure their consistency and reveal beneath potential importance in thrombocytopenic state, hence maximizing clinical outcomes and make shortcut to the diagnosis.

MATERIALS & METHODS

Study design: The study had has prospective cross sectional hospital based design and was conducted at Ahmed Gasim Hospital and Radiation and Isotopes Centre-Khartoum from November 2013 to March 2014.
Ethical considerations: The ethical requirements were obtained written and authorized from "general directorate of training and development" and from "curative medicine directorate" in ministry of health of Khartoum state to initiate the study in Khartoum state hospitals.
In targeted hospitals others ethical requirements approval were obtained written and authorized from "training and research administrations department". Patient's preparation and safety and necessary subsequent inquiries were handled by hospital personnel as part of their preparation for thrombocytopenic patients on their clinic day follow up at

which sample collection discipline was on step of the routine patients follow up collected samples.

Study population: Sudanese patients and healthy one were the targeted population. A concurred diagnosis was the major inquiry for those conditions associated with thrombocytopenia which were (5) conditions, included, the heart disorders and inhabitants were sorted accordingly, the lymphoid neoplasms, and inhabitants were sorted according to WHO classification, the renal transplantation, and inhabitants were sorted accordingly, the chemotherapy, and inhabitants were sorted accordingly, the hypoplastic bone marrow, and inhabitants were sorted by bone marrow examination dependency method. The 6th condition included the healthy Sudanese population and was sorted according to normal, physical examination, systemic review and laboratory physiological assessment.

Inclusion criteria: Inclusion criteria included clinically active patients whom were diagnosed in the entirety of studied thrombocytopenic conditions and fully checked healthy individuals.

Exclusion criteria: Excluding criteria included patients with hypersplenism regardless to the cause, in addition to history of blood or any blood product transfusion prior 15 days of sample collection.

Sample size: Collection encountered (366) samples, Among the (366) samples (190) were rejected by samples quality control checking system after they were measured by Sysmex KX-21N, that making final total of (176) results from which cross pounding population of interest were put forward to the study induction, the gender distribution over it was (99) for males and (77) for females.

Sample collection:

Prospective collected samples: Blood samples were collected by vein puncture phlebotomy and drawn into EDTA anti-coagulant container in ratio of 1.5 mg / 1 mL of whole blood. The well mixed samples were immediately enrolled into the autoanalyzer Sysmex KX-21N.

Samples quality control checking system: In this system, platelet histogram errors flag was carefully inspected to eliminate unreliable erroneous flagged results. The checking system had come across multiple PVI value choices for same patients. There were multimodal values at same frequency of PVI either higher or lower than reference range among them other values within reference range* for same patient. These values were tested in period between (2 to 7) days at steady low PLT count state. ** Checking system had chosen those patients result depending on frequency of highest or lowest value on attendant of frequency mode. The highest or the lowest value of which, was considered the representative numerical data for PVI.

Data Collection: The data was collected from patient files, including patient demographic parameters, history, clinical presentation, type of drugs used, complete blood count (PLT count and PLT indices).

Data analysis: The data was analyzed using SPSS version 20 with descriptive statistics using frequency tables for qualitative variables while mean and stander deviation are done for quantitative variables, for detecting correlation between two quantitative variables using person correlation test, for detection of difference independent T test and one way ANOVA test with post hoc LSD test for multiple comparison. P<0.05 was considered to indicate statistically significant differences, negative correlation indicates inverse relationship, and positive correlation indicates direct relationship.

RESULTS

In total, 176 convenient samples were encountered and sorted according to the diagnosis into (6) conditions with no age relevancy, males comprised 99 samples while females were 77 samples. Table 1 shows the distribution of the clinical condition in percentage. Platelet volume index (PVI) is illustrated in (Figure 1) to demonstrate the variations in different condition, according to mean. The total (18) correlations between PLT count and PVI are illustrated in table (2).

Table 1: Shows the conditions and frequency of the study population.

Condition	Frequency	%
Heart disorders (HD)	48	27.3
Renal transplantation (RT)	20	11.4
Lymphoid neoplasms (LN)	37	21
Chemotherapy (CT)	28	15.9
Hypoplastic bone marrow (HPB)	13	7.4
Healthy Sudanese population (HSP)	30	17
Total	176	100

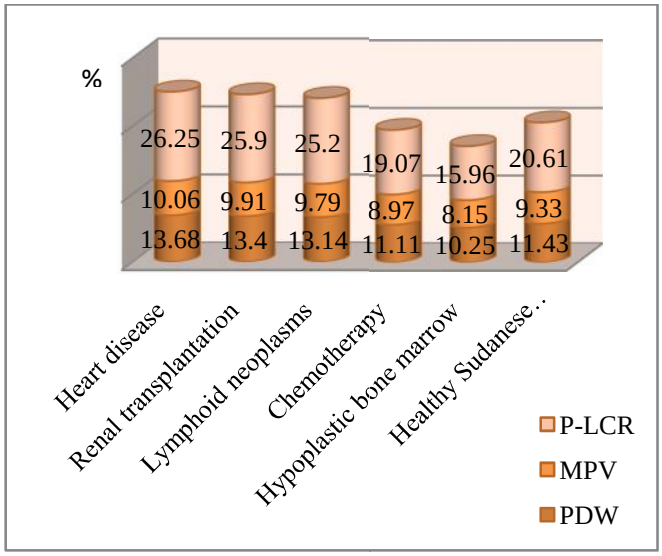

Fig 1: PVI variation according to the mean values.

In thrombocytopenic conditions the (15) correlation revealed (9) inverse correlations between PLT count and PVI, (1) reverse correlation between PDW & PLT count in CT, and (4) non-significant correlations (between

PDW&PLT count in HPB and RT, between MPV& PLT count in CT, and between P-LCR & PLT count in CT), while the resting (3) correlation in HSP were insignificant. The correlations between PVI were determined as in Table (3).

Table 2: Correlation between PLT count and PVI in the study population

Condition	PLT count	Pearson Correlation	P value
Heart disorders	PDW	-0.402	0.005
	MPV	-0.365	0.011
	P-LCR	-0.384	0.007
Renal transplantation	PDW	-0.424	0.062
	MPV	-0.524	0.018
	P-LCR	-0.557	0.011
Lymphoid neoplasms	PDW	-0.432	0.008
	MPV	-0.565	0.000
	P-LCR	-0.513	0.001
Chemotherapy	PDW	0.336	0.080
	MPV	0.278	0.152
	P-LCR	0.217	0.267
Hypoplastic bone marrow	PDW	-0.099	0.749
	MPV	0.084	0.786
	P-LCR	-0.211	0.490
Healthy Sudanese population	PDW	-0.259	0.167
	MPV	-0.147	0.439
	P-LCR	-0.198	0.295

-P<0.05 indicate statistically significant differences.

-Negative correlation indicates inverse relationship, and positive correlation indicates reverse relationship.

Table 3: Correlation between the MPV, PDW, and P-LCR in the study population

Condition	Parameter	Pearson Correlation	P value
Heart disorders	PDW and MPV	0.840	0.000
	PDW & P-LCR	0.873	0.000
	MPV & P-LCR	0.902	0.000
Renal transplantation	PDW & MPV	0.808	0.000
	PDW & P-LCR	0.887	0.000
	MPV & P-LCR	0.975	0.000
Lymphoid neoplasms	PDW & MPV	0.854	0.000
	PDW & P-LCR	0.877	0.000
	MPV & P-LCR	0.974	0.000
Chemotherapy	PDW & MPV	0.933	0.000
	PDW &P-LCR	0.942	0.000
	MPV & P-LCR	0.938	0.000
Hypoplastic bone marrow	PDW & MPV	0.614	0.025
	PDW & P-LCR	0.459	0.115
	MPV & P-LCR	0.852	0.000
Healthy Sudanese population	PDW and MPV	0.918	0.000
	PDW & P-LCR	0.944	0.000
	MPV & P-LCR	0.991	0.000

-P<0.05 indicate statistically significant differences.

-Negative correlation indicates inverse relationship, and positive correlation indicates reverse relationship.

It was significant positive in all except for the correlation between PDW and P-LCR in hypoplastic bone marrow it was insignificant.

DISCUSSION

The study aims at enlightening laboratory technologists and physicians in Sudan about PVI in tie with PLT count and brings more attention to which had remained vague for more than a decade and measures the PVI weight in front of none recommended clinical use, alongside dragging these parameters in to claim of clinical significance using the specific objectives. The study took account of PLT count to manifest the clinical area of the study.

No previous study has been found in such, the study, conditions sorting and disorders gathering to make complete match, but partial comparisons were founded.

Preliminary study was conducted to verify there is no significant difference in the PVI and occurrence of homogeneous values among different disorders of same condition; it was based on PLT count at steady states, and reveals normal PVI at normal PLT count and fluctuations from which up and down at thrombocytopenic state.

Measurement and calculation of mean and standard deviation for PLT count and PVI, the means in thrombocytopenic conditions revealed PVI trend to favor particular pattern, in heart disorders, lymphoid neoplasms, and renal transplantation the trend favors clustering to higher values than healthy Sudanese population, and in chemotherapy and hypoplastic bone marrow the trend favors clustering to lower values than healthy Sudanese population. In same regard when comparing mean of healthy Sudanese population with reference range and others two studies have been done in Chinese Han population [5] and Brazillian population [6] , it was lower values than in those compared and the figures in those compared were, PDW (12.35 fl), (14.45 fl) and (12.45 fl), MPV (10.40fl) ,(11.2 fl), and (10.35fl), and P-LCR (25%,) (35.05%) and (27.5%) respectively. Another study [7] interested in a single heart disease, when compared, came up with same study outcome but unmatched figures for PDW and MPV, it states: “patients with heart disease had increased MPV and PDW values, compared to non-embolics and control (10.62±1.13 vs 9.25±0.97 and 8.93± 0.82 fl, p <0.001) and (16.31±2.42 vs 14.35 ± 1.97 and 14.04 ± 1.82 %, p < 0.001) respectively”. Another similar heart disease study [8] had matched the study outcome, echoed: “Patients with heart disease had higher PVI and lower platelets counts compared with those with the normal population”, with PVI (10.97) in acute coronary syndrome versus (10.03) instable angina and (9.12) in normal population, (p<0.001) within total of (180) subject. These

matched outcomes justify the concept of the gathering different disorders in case of heart disorder condition and clustering to a favored pattern higher than normal range. Other study [9] in Korea relating to hypoplastic bone marrow, among (136) aplastic anemia cases and (87) ITP cases, had measured the PDW and MPV, although both were within reference intervals there were significant difference between them, concluding: "The MPV and PDW may be useful in the differential diagnosis of aplastic anemia and ITP in patients with thrombocytopenia". This suggests more; than usefulness of PVI, it insures the favors of clustering in to certain pattern in thrombocytopenic conditions.

In same regard unlikely lymphoid neoplasms has been found to favor clustering into higher range beyond healthy Sudanese population contrary to favor the vice versa on accordance to bone marrow involvement.

In same regard, although mean of PVI that represents a pattern is cluster specific, a significant overlap exists. These overlapped values have being called the "interchangeable values". Thereby when considering STD of mean a conclusion can be made: "the highest obtained value from first cluster (higher than healthy population) or the lowest obtained value from second cluster (lower than healthy population), the better, the differentiator between patterns and the presence of interchangeable values would omitted that pattern differentiation in a thrombocytopenic state". The interchangeable values mostly are of the affection of related co-founders, but the study offers a solution; within laboratory practical wise via what have being called the "X-protocol" which makes PVI optimal value come into view after multiple blood sampling for particular patient of interest, in this instance extremities value of either clusters usually pop up, this value have being called the "X-value". Adding up calculation of mean or else determination of optimal mode with in serial PVI collected values, this would emerge the X-value to be expressed and the condition or disorder settles into particular pattern. Although PVI is a reflection of underlining mechanism triggered by a disorder result in a decrease of PLT count and change of PVI from normal to abnormal either higher or lower than healthy Sudanese population, a definition can be made for these inducted findings: "the interchangeable value is unchanged PVI (in normal range) in thrombocytopenic state and the X-value is assumption a hidden value to that state but unexpressed and has been omitted by co-founders, this can be reassuming by multiple sampling (X-protocol) which can result in presence of discriminating pattern value either higher or lower than the normal population range (X-value)". The assessment of these findings has gave up a clarification to the contradiction among studies, and the sustained non-recommended use of PVI in clinical practice, apparently the contradiction was dependent upon which value has been taken by chance in different studies, the interchangeable value or pattern discriminator value. This is founded disadvantage of the interchangeable value is a considered reason that had insure the strong affection of co-founders in thrombocytopenia.

The absence of X-value had make speculation if chances of clustering to optimal PVI value after multiple sampling by X-protocol would be obtain or not, if not, indicate the presence of strong co-founders, and this would exclude PVI advantage of being useful which could of have this advantage if yes which indicate resolution of co-founders by X-protocol and obtaining of the X-value instead of the interchangeable value.

Regarding correlations between PLT count and PVI the (3) insignificant correlation in healthy Sudanese population does not match the principle fact "there is an inverse relationship between PLT count and size in normal subject", this is explainable because there were no enough ascending PLT count s samples from the lowest PLT count of normal range to the highest of normal range, massive sampling possibly can exit the inverse relationship and possibly can concur to the obtained insignificant study correlations because of physiological variation in normal subject is no exception.

In the same regard when judging the others obtained (9) negative (inverse) and (1) positive (reverse) correlations between PLT count and PVI in thrombocytopenic conditions it does cross pond with the clustering to higher or lower than healthy one, except the negative correlation in hypoplastic bone marrow, which is explainable when considering the interchangeable value and when judging the others (4) insignificant correlations between PLT count and PVI in thrombocytopenic conditions it does signify the presence of interchangeable values.

Regarding correlation between the MPV, PDW, P-LCR the (17) positive (reverse) correlations in study population does serve the analytical strength of PVI, and indicate their stability among different conditions and their constant changing rates which would make confidence to their utility. However interchangeable values affection does not come into view, except in one insignificant correlation between PDW and P-LCR in hypoplastic bone marrow.

Differences of PLT count and PVI according to gender it was insignificant in all conditions and this has made a match with the previous mentioned Brazillian study [6] which had pointed out insignificant gender differences, however in reference range it is slight difference in which the PDW mean is (11.8 fl) for males, and (12.9 fl) for females, the MPV mean is (10.05 fl) for males, and (10.75 fl) for females, and the P-LCR mean is(25%) for males and females.

CONCLUSION

In thrombocytopenic conditions the PVI has the ability to change from normal range to either higher or lower than healthy Sudanese population. Sudanese population has PVI mean lower than the mean of reference range, Chinese Han population, and Brazillian population.

There are detectable inverse and reverse correlations 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 sampling).

The contradiction between studies and the non-recommended clinical use of PVI is due to the presence of interchangeable values and resolution of interchangeable value can be done by X-protocol to obtain the X-value to seats diagnosis on a short cut.

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