ORIGINAL ARTICLE

Reference Ranges of Platelet Indices using Automatic Hematology Analyzer

Nadeem Nusrat[*], Zaen elabdeen Pahore[*], Muhammad Akbar Agha[**], Saima Minhas[*], Shaheen Sharafat[***]

ABSTRACT

Objective: To determine local reference range of platelet indices, comparison it between the two genders and internationally published ranges.

Study Design: Cross sectional

Place and Duration: Dr.Ishrat elabad Khan Institute of Hematology, Dow University of health sciences, Karachi, Pakistan, from 1st to 31st March 2014.

Material and Methods: First 10,000 CBC samples coming to our institute during the study period were included and after a strict inclusion and exclusion criteria only 4202 CBCs were selected for the study. The investigation was performed in Cell Dyne Ruby, five parts automatic hematology analyzer. The CBCs were divided into seven groups ranging from neonate till 60 years of age. The four platelet parameter including platelet count, PTC (Plateletcrit), MPV(Mean platelet volume) & PDW (Platelet distribution width) were recorded and transferred to SPSS version 16, They were calculated for Mean, Median, Mode, Standard deviation in addition to comparison between genders and international published reference range by applying t-test and calculating significance with 95 % confidence interval.

Results: Following reference ranges were obtained.

MPV – males >18 years 6.69-11.09 fl, b/w 10-18years 6.06-10.78 fl, females >18 years 6.78-10.43 fl, b/w 10-18years 6.67--10.70 fl, b/w 1-10 years both sexes 5.21-9.33 fl, b/w 1-11 months both sexes 5.2-8.10 fl and neonates both sexes 5.8-10 fl.

PCT-males >18 y 0.17-0.29, b/w 10-18years 0.17-0.30, b/w 1-10 years both sexes 0.16-0.31, b/w 1-11 months of both sexes 0.20-0.34 & neonates 0.08-0.33, adult females 0.23-0.30 female b/w 1-10 years 0.18-0.30.

PDW – males >18 years 18.94-21.64, b/w 10-18 years 18.59-21.40, females > 18years 18.84-21.50, b/w 10-18years 18.61-21.18, b/w 1-10 years both sexes 17.95-20.65, b/w 1-11 months 17.86-20.74, neonates 19-22.5.

Conclusion: A local reference range was established with no statistically significant difference between the two genders except minor variations in platelet counts and MPV. Our results showed slight difference in values from the internationally published data.

Key words: Plateletcrit (PCT), Mean platelet volume (MPV), Platelet distribution width (PDW).

[*] Assistant Professor, Pathology Deptt, Dow International Medical College, DUHS, Karachi.

[**] Professor & Director, DIEKIBD, DUHS, Karachi.

[***] Professor & Head, Microbiology, Dow International Medical College, DUHS, Karachi.

Correspondence to:

Dr. Nadeem Nusrat
Assistant Professor,
Depatment of Pathology
Dow International Medical College,
DUHS, Karachi
Cell: 0333-2907020
Email: nadeem.nusrat@yahoo.com

INTRODUCTION:

Automation in laboratory medicine has made it possible to get quick, accurate and precise results. At the same time these analyzers perform calculations on the parameters to give values that are reproducible and can be helpful in further enhancing the understanding of clinical settings. Hematology analyzers can now perform platelet indices which include PCT, MPV and PDW[1] and offer great information about the morphology and maturity of platelets. In a routine CBC report, these parameters are not reported as clinicians are not aware of their availability[2] and most of the time there is no local reference range with which the

patient results could be compared and interpreted[3]. The reference ranges of these parameters are given by the manufacturer and may not be valid for that population. There is no doubt that there should be a local reference range obtained by these analyzers in a healthy sample population which should be well defined, accurate and precise leading to prompt interpretation of results, thus preventing unnecessary and costly follow-up laboratory investigations and medical examination[4].

Platelet indices, namely plateletcrit (PCT), mean platelet volume (MPV) and platelet distribution width (PDW) are measured, calculated and reported by the Cell-Dyne Ruby analyzer from Abbot. PCT is just like Hct and informs about the percentage of volume occupied by the platelets and is a reflection of platelet count and size. It can be increased when there are large platelets. MPV reflects the average size of platelets and is just like MCV of red cell indices and is increased with large platelets. PDW reflects the variation in size and is present when there is anisocytosis of platelets.

Platelet indices have a significant role in assessment of thrombocytopenia and may reflect the activity of bone marrow, when underproduction does not lead to increase in MPV and PDW while peripheral destruction can cause a rise in these two parameters when the platelets are larger in size with increased anisocytosis[5], thus avoiding bone marrow procedures for diagnosis of low platelet counts[6]. On the other hand PCT and PDW are helpful in differentiating myeloproliferative disorders from cases of reactive thrombocytosis[7-8].

Platelet indices are exerting their importance in evaluating the thrombotic tendencies in cases of at risk patients of certain diseases such as coronary artery disease, diabetes mellitus, pre-eclampsia, Alzheimer's disease, thrombosis, myeloproliferative disorder, inflammatory bowel and renal diseases[9]. Information regarding platelet indices is sparse in Pakistan and to best of our knowledge we have not come across any such study in this part of world.

MATERIAL AND METHODS:

This prospective descriptive study was conducted in Dr. Ishrat ul Ebad Khan Institute of Hematology during 1st to 31st March 2014. All the patients coming for CBC were asked about their drug and bleeding history including their diagnosis. Only those samples were selected who came for routine check up or with mild ailments and did not have any significant disease, bleeding & drug history like aspirin, NSAIDs and anticoagulants. The data of 10,000 samples were collected but only 4202 were selected for this purpose. The selection criterion was samples with normal Hb, RDW, Platelet and white blood counts for the age and sex of the individual. This sample size consisted of all age groups (Neonates from birth till 60 years) of both sexes and all the ethnic groups. The total samples were divided into seven groups as follows: Neonates from birth till one month, Children from more than one month till 12 months, from more than 1 year till 10 years, from more than 10 to 18 and from more than 18 till 60 years. 2 ml of whole blood sample was taken from good peripheral vein in EDTA purple top with a vacutainer and CBC was performed within 3 hrs of sample collection in Cell Dyne analyzer. Ruby incorporates (MAPSS) Multi-Angle Polarized Scatter Separation technology with two dimensional optical platelet analysis at zero and 10 degrees. The MPV is calculated by the following formula: MPV (fl) = [(platelet (%) / Platelet count (x109/l). PCT is the ratio of the platelet volume in relation to blood volume. PDW is the width of the size distribution curve in femtoliter (fl)10. The quality assurance was our daily routine comprising of three times a day of normal, high and low commercially prepared controls and documented as a routine in Levy Jennings (LJ) chart well within Westgard rules. All the data was entered in Excel, Filters were applied to get CBCs with normal Hb, RDW and transferred to SPS version 16. Descriptive statistics namely mean, median and standard deviations were calculated as the data produced a Gaussian distribution. The differences between the male and female groups were determined by paired t-Test

RESULTS:

Total of 4202 samples from healthy persons were taken (table-1), 222 were upto ten years of age, 126 & 2543 males from more than 10-18 years of age and more than 18-60 years respectively while 117 & 1194 females from more than 10-18 years of age and more than 18-60 years of age respectively. Following reference ranges were obtained;

MPV – males >18 years 6.69-11.09 fl, b/w 10-18years 6.06-10.78 fl, females >18 years 6.78-10.43 fl, b/w 10-18years 6.67--10.70 fl, b/w 1-10 years both sexes 5.21-9.33 fl, b/w 1-12 months both sexes 5.2-8.10 fl and neonates both sexes 5.8-10 fl.

PCT-males >18 y 0.17-0.29, b/w 10-18years 0.17-0.30, b/w 1-10 years both sexes 0.16-0.31, b/w 1-12 months of both sexes 0.20-0.34 & neonates 0.08-0.33, adult females 0.23-0.30, female b/w 1-10 years 0.18-0.30.

PDW – males >18 years 18.94-21.64, b/w 10-18 years 18.59-21.40, females > 18years 18.84-21.50, b/w 10-18years 18.61-21.18, b/w 1-10 years both sexes 17.95-20.65, b/w 1-12 months 17.86-20.74, neonates 19-22.5.

DISCUSSION:

The sample was divided into various age groups, their distribution produced a -Gaussian distribution Each group had mean, median mode, SD, minimum and maximum values of the platelet parameters Table-2. From newborn till 10 years of age we included both genders in common while from 10 years onwards, as the people enter puberty, they were divided into male and female groups as the parameter values may change according to sex.

Platelet count increased from neonatal period and reached their peak before completion of first year and then started decreasing to 350 after the first year and by the end of 9th year reached to their lowest but normal value of 296 +- and this value was sustained till 60 years of age. The same trend from neonatal period till 60 years of life was seen in PCT and PDW. MPV decreased from birth till end of first year and then started increasing from this period till 10 years and then remained stable at an increased level from neonatal period till 60 years of age Platelate count was higher in neonates but lower after first year and this trend was followed for rest of age limit. On comparison with other studies It was noted that our local values are

Table-1. Comparison of local platelet values with the published values

Total n = 4202	Local Plat count ×10⁹/l Published count ×10⁹/l	Local PCT Published PCT	Local MPV(fl) Published MPV(fl)	Local PDW % Published PDW
Neonate n 36	150-456 **200-450**	0.08-0.33	5.8-10 **7.4-10.4**	19-22.5
Children n 62 >1 m-12 m	284-608 **250-750**	0.20-0.34	5.2-8.10 **7.4-10.4**	17.86-20.74
Children n 124 >12 m-10 y	238-462 **250-550**	0.16-0.31	5.21-9.33 **7.4-10.4**	17.95-20.65
Female n 117 >10 y-18 y	294-387 **150-450**	0.18-0.30 **0.23-0.24**	6.67-10.70 **7.4-10.4**	18.61-21.18 **10.0-17.9**
Female n 1194 >18 y--60 y	220-352 **140-440**	0.23-0.30 **0.23-0.24**	6.78-10.43 **7.4-10.4**	18.84-21.50 **10.0-17.9**
Male n 126 >10 y -18 y	207-385 **150-450**	0.17-0.30 **0.23-0.24**	6.06-10.78 **7.4-10.4**	18.59-21.40 **10.0-17.9**
Male n 2543 >18 y-60 y	209-341 **140-440**	0.17-0.29 **0.23-0.24**	6.69-11.09 **7.4-10.4**	18.94-21.64 **10.0-17.9**

Lubin BH, "Reference Values in Infancy and Childhood– Hematology of Infancy and Childhood" Nathan DG, and Oski FA 2nd ed, Philadelphia PA, WB Saunders Co 1981, 1552-74.

Miller. Normal Value and Examination of Blood: Perinatal Period, Infancy, Childhood and Adolescence."Blood Diseases of Infancy and Childhood, 5th ed, St Louis, MO: CV Mosby co. 1984, 21-36.

Novak RRW, "Red Cell Distribution Width in Pediatric Microcytic Anemias," Pediatrics, In press. Laboratory Reference Range Study, BCH, Adult values, 1996 HE1A.696

Table-2.   **Platelet values according to age and gender**

	Neonates		31 D > 12 m		Children 1- 10 y		Female 10-18 y		Male 10 -18 y		Female adult		Male adult	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Plat	289	167	446	162	350	112	297	85	296	89	286	66	296	89
PCT	0.212	0.123	0.285	0.083	0.284	0.07	0.245	0.059	0.24	0.06	0.24	0.062	0.24	.06
MPV	7.9	2.1	6.65	1.45	7.27	2.06	8	2.27	8.4	2.31	8.9	2.14	8.41	2.3
PDW	20.8	1.75	19.30	1.44	19.3	1.35	20	1.28	19.9	1.4	20.17	1.30	19.9	1.4

Table-3   **Statistical significance in platelet values between the two genders**

	Female 10-18 yrs	Male 10-18 yrs	P-Value	Female > 18 yrs	Male > 18 yrs	P-Value
Plat count	297 +- 85	296 + - 89	0.37	286 + - 66	296 + - 89	1.62
PCT	0.245+ - 0.059	0.24 +- 0.06	0.55	0.24 + - 0.062	0.24+ - 0.06	0
MPV	8 + - 2.27	8.4 + - 2.31	0.85	8.9 + - 2.14	8.41+ - 2.3	0.39
PDW	20 + - 1.28	19.9 + - 1.4	0.50	20.17 + - 1.30	19.9 + - 1.4	1.18

nearly the same but sometimes differ slightly,. From the neonatal till 10 years of age, we could not come across any study regarding PCT and PDW values and so they could not be compared with them. 10 years onwards both PCT and PDW were higher while MPV values were slightly lower in our study till the age of 10 years and then showed an upward value since that age till 60 years of age. Table-3 shows gender comparison in our study with only minor variation in the values but statistically, there was no significant difference.

These values are of immense importance in a clinical setting where a rapid working and provisional diagnosis is to be made and decisions about further investigations and treatment are sorted out.

Different studies have been done in various diseases. It has been shown that there is significant change in platelet indices preceding the development of microvascular angiopathy in diabetes mellitus[11,12]. Pre-Eclampsia is also a condition in which platelet indices show significant changes especially in MPV[13]. These indices have also proved their value in patient suffering from unstable angina, myocardial infarction and undergoing per-cutaneous angioplasty in addition to predict the prognosis after such procedures[14,15].

Neonatal septicemia is also accompanied by alteration in platelet count and indices and can be helpful in diagnosis and in predicting prognosis[16].

CONCLUSION:

This is the first time, that normal local reference range of platelet indices has been established in our population, which despite of minor variations do not differ significantly from other studies and may be quiet helpful in clinical settings particularly in evaluation of many disorders like thrombocytopenia, stroke risk in diabetes mellitus, Pre-Eclampsia, unstable angina, myocardial infarction, post therapeutic cardiac procedures and neonatal septicemia.

REFERENCE:

1. Yang D, Zhou Y, Chen B. Performance evaluation and result comparison of the automated hematology analyzers Abbott CD 3700, Sysmex XE 2100 and Coulter LH 750 for cell counts in serous fluids. Clin Chim Acta. 2013;419:113-8.

2. Botma J, Mogongoa LF, Jaftha AD, Janse W. Reference ranges for platelet indices using Sysmex XE -2100blood analyser: Medical Technology SA. 2012;26(2):17-21.

3. Lewis SM, Bain BJ, Bates I, Dacie JV. Dacie and Lewis Practical Haematology, 10th edition. Philadelphia: Churchill Livingstone, 2006.

4. Ntaios G, Papadopoulos A, Chatzinikolaou A, Saouli Z, Karalazou P, Kaiafa G, et al. Increased values of mean platelet volume and platelet size deviation width may provide a safe positive diagnosis of Idiopathic Thrombocytopenic Purpura. Acta Haematol. 2008;119(3):173-7.

5. Ken K, Hiroko O, Noriko U, Miyuki Y, Jyunko T, Etsuko K, et al. Platelet size deviation width, platelet large cell ratio, and mean platelet volume have sufficient sensitivity and specificity in the diagnosis of immune thrombocytopenia. BJH. 2005;128(5):698-702.

6. Chandra H, Chandra S, Rawat A, Verma SK. Role of MPV as discriminating guide for bone marrow disease in patients with thrombocytopenia. Int J Lab Hematol. 2010; 32(5):498-505.

7. Numbenjapon T, Mahapo N, Pornvipavee R, Sriswasdi C, Mongkonsritragoon W, Leelasiri A, et al. A prospectiveevaluation of normal mean platelet volume in discriminating hyperdestructive thrombocytopenia from hypoproductive thrombocytopenia. Int J Lab Hematol. 2008;30(5):408-14.

8. Song YH, Park SH, Kim JE, Ahn JY, Seo YH, Park PH, et al. Evaluation of platelet indices for differential diagnosis of thrombocytosis by ADVIA 120. Korean J Lab Med. 2009;29(6):505-9.

9. Giacomini A, Legovini P, Gessoni G, Antico F, Valverde S, Salvadego MM, et al. Platelet count and parameters determined by the Bayer ADVIA TM 120 in reference subjects and patients. Clin Lab Haematol. 2001;23(3):181-6.

10. Briggs C, Harrison P, Machin SJ. Continuing developments with automated platelet count. Int J Lab hematol. 2007;29(2):77-91.

11. Hekimsoy Z, Payzin B, Ornek T, Kandogan G. Mean platelet volume in Type 2 diabetic patients. J Diabetes Complications. 2004;18(3):173-6.

12. Jindal S, Gupta S, Gupta R, Kakkar A, Singh HV, Gupta K, et al. Platelet indices in diabetes mellitus: indicators of diabetic microvascular complications. Hematology. 2011;16(2):86-9.

13. Freitas LG, Alpoim PN, Komatsuzaki F, Carvalho Md, Dusse LM. Preeclampsia: are platelet count and indices useful for its prognostic?. Hematology. 2013;18(6):360-4.

14. Tomasz R, Aleksandra J, Jakub F, Maria KP, Karina WD, Michal P, et al. Prognostic value of platelet indices after acute myocardial infarction treated with primary percutaneous coronary intervention. Cardiol J. 2013;20(6):491-8.

15. Vitthal K, Jayaraj S, Deepak K, Komal R, Shobha N. Mean platelet volume and other platelet volume indices in patients with stable coronary artery disease and acute myocardial infarction: A case control study. J Cardiovasc Dis Res. 2012;3(4):272-5.

16. Abdalla A, Mohammed M, Wadah K, Sulaiman S. The Effect of Neonatal Sepsis on Platelet Count and their Indices. J Med J. 2008;42(2):82-6.