

Original Article

Platelet Parameters in Healthy Subjects Analysed by Automation Analyser

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Abstract: Blood sample collected after venipuncture from healthy volunteers were used to determine platelet count (438 cases), mean platelet volume (MPV) (438 cases), plateletcrit (PCT) (255 cases) and platelet distribution width (PDW) (255 cases). Recently, the introduction of automated cell analyser with platelet parameters have become available on a routine basis, so it is important to evaluate platelet size relationship. This study established reliable reference ranges for these platelet parameters, while taking into consideration the effects of age and sex. The higher platelet count in women was confirmed. An inverse non-linear relationship between the platelet count and the mean platelet volume was found. Plateletcrit showed no variation with respect to age, and a direct linear relationship was found between PCT and platelet count with $r = 0.879$. PDW showed no variation with respect to age. These platelet parameters are helpful as diagnostic aids.

Key Words : ● Platelet count ● Mean platelet volume ● Plateletcrit ● Platelet distribution width
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Automated blood cell analyzers have been evolving since the late 1960s and the instruments now are available and capable of identifying, mixing and analysing blood samples at

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a rate of up to 120/hour with accuracy and precision. Automated particle counting and sizing technology have made platelet count and size readily available as part of the routine automated blood count.¹⁵ Platelet parameters may become increasingly important in evaluating the integrity of the thrombocytic function. For example, particle sizing has been used to distin-

guish immune from hypersplenic⁶ or infiltration thrombocytopenia⁷. The platelet count and the mean platelet volume (MPV) have been suggested as useful parameters.^{8, 9}

The MPV may be as important as the platelet count in determining platelet homeostasis¹⁰ and the thrombocytocrit (PCT) has been proposed as a measurement of platelet mass.¹¹ In addition, the MPV may serve as a guide to predict the risk of hemorrhage in thrombocytopenic patients¹², patients with thrombocytopenia resulting from loss or consumption has a higher MPV than with marrow failure.¹³⁻¹⁵

The purpose of this study is to establish tentative reference ranges for the platelet count, MPV, PCT and PDW in a selected population, while the effects of age and sex variables are taken into consideration. This study is prospective study.

Materials and Methods

Volunteers were healthy joined the check up program, and had not taken any drugs. The blood samples used in this evaluation were drawn by venipuncture into potassium-EDTA anticoagulant tubes, allowed to stand at room temperature after venipuncture for two to three

hours before these studies were done. The Coulter Counter model Max M (Coulter Electronics, Hialeak, Florida) was used to determine platelet count, MPV, PCT and PDW. The results were grouped by age according to decade and by sex.

Results

Platelet count

Table 1 represents the results for all the platelet parameters studied. The mean platelet count for the entire group of 438 people, ranging in age from 16 to 60 years was $272 \times 10^9/L$. The results of platelet count are diagramatic in fig 1. The platelet counts in male and female were not significantly different (table 2). The groups were divided into ten years intervals (table 3).

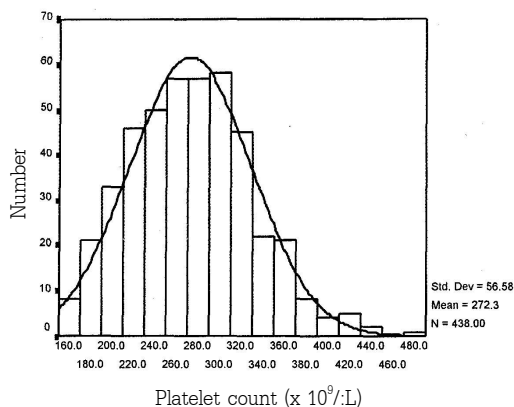


Fig. 1 Histogram of the distribution of platelet count

Table 1. Platelet parameters in healthy subjects

Parameter	N	$\bar{X} \pm SD$	Variance	SE	Kurtosis	SE skew	Kurtosis	Skewness	Range	Min-Max
Platelet count (x10 ⁹ /L)	438	272.34±56.57	3,200.74	0.233	0.117	0.117	0.381	323.000	151 - 474	
MPV (fL)	438	7.945±0.715	0.511	0.233	0.117	0.782	0.437	5.300	5.6 - 10.9	
PCT (%)	255	0.221±0.038	0.001	0.304	0.153	-0.109	0.366	0.181	0.141 - 0.322	
PDW (%)	255	15.786±0.425	0.181	0.304	0.153	1.116	0.756	2.700	14.9 - 17.6	

Table 2. Comparison of platelet parameters in males and females

Parameter	Sex	n	$\bar{x} \pm SD$	t-test
Platelet count ($\times 10^9/L$)	M	157	267.32 ± 55.51	p = 0.140
	F	281	275.15 ± 57.07	
MPV (fL)	M	157	7.80 ± 0.66	p = 0.002
	F	281	8.02 ± 0.73	
PCT (%)	M	101	0.21 ± 0.035	p = 0.021
	F	154	0.23 ± 0.039	
PDW (%)	M	101	15.87 ± 0.44	p = 0.01
	F	154	15.73 ± 0.41	

Table 3. Platelet parameters in age (mean $\pm$ SD)

Age (years)	Platelet count ($\times 10^9/L$) (n)	MPV (fL) (n)	PCT (%) (n)	PDW (%) (n)
16-25	266.16 ± 62.28 (70)	7.81 ± 0.72 (70)	0.24 ± 0.04 (13)	15.75 ± 0.42 (13)
26-35	260.82 ± 49.91 (131)	8.07 ± 0.73 (131)	0.21 ± 0.04 (73)	15.81 ± 0.41 (73)
36-45	279.87 ± 56.44 (159)*	7.93 ± 0.71 (159)	0.22 ± 0.03 (103)	15.76 ± 0.44 (103)
46-55	285.03 ± 58.91 (73)*	7.91 ± 0.67 (73)	0.23 ± 0.04 (61)	15.79 ± 0.42 (61)

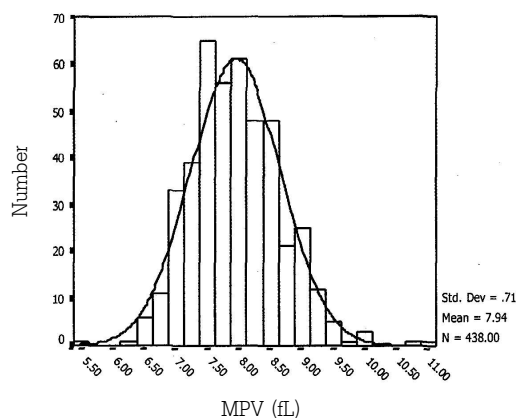
Scheffe test

Platelet count : Two group are significantly different at $p < 0.05$ (Age 26-35 : Age 36-45, Age 26-35 : Age 46-55)

Comparison platelet count between age group was significantly different at age 26-35 and age 36-45, age 26-35 and age 46-55.

Mean platelet volume

The results are summarized in table 1, fig 2. The mean platelet volume for the entire group of 438 people was 7.945 fL. Comparison between male and female was significantly different that female MPV were higher than male MPV. (Table 2) There was no evidence of a patterned relationship when different ages were compared. When the MPV was compared as a function of platelet count (Fig 3), there was found

**Fig. 2** Histogram of the distribution of MPV

to be an inverse, nonlinear relationship between the two parameters. (correlation coefficient - 0.415, table 4)

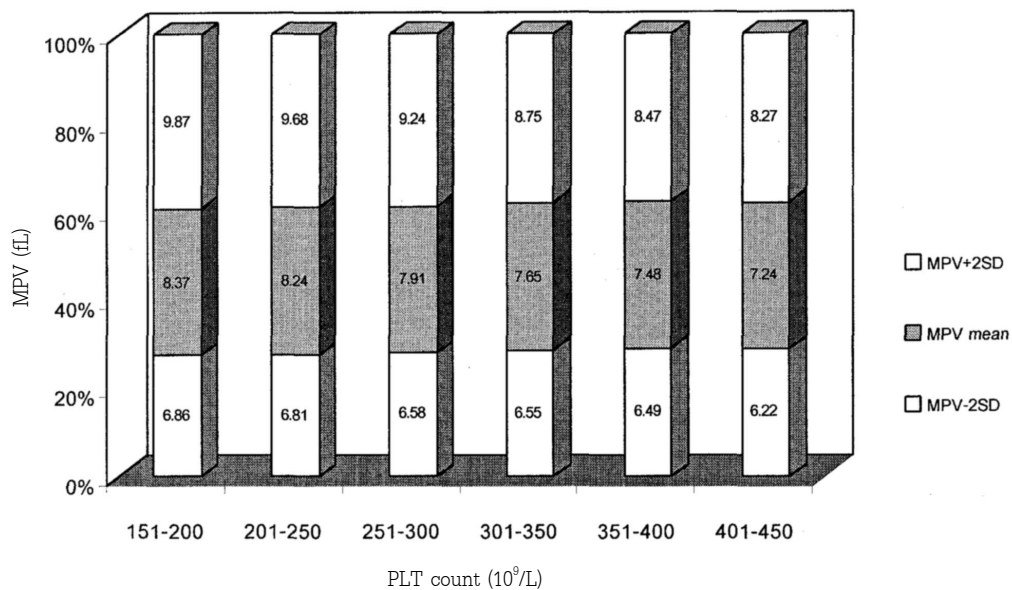


Fig. 3 Relationship between MPV and platelet count

Table 4. Show the correlation coefficient

	Platelet count ($\times 10^9/L$)	MPV (fl)	PCT (%)	PDW (%)
Platelet count	1.000	- 0.415**	0.879**	- 0.137*
MPV	- 0.415**	1.000	0.008	- 0.067
PCT	0.879**	0.008	1.000	- 0.157*
PDW	- 0.137*	- 0.067	- 0.157*	1.000

** Correlation is significant at the 0.01 level (2 tailed)

* Correlation is significant at the 0.05 level (2 tailed)

Plateletcrit

The information gathered for PCT is presented in table 1, and fig 4. Comparison value between male and female was significantly different. The ranges of PCT in each of the age group remained relatively stable. This was a direct, approximately linear relationship noted between PCT and platelet count (Fig 5) and correlation coefficient 0.879 (Table 4).

Platelet distribution width (PDW)

The results are summarized in table 1, and

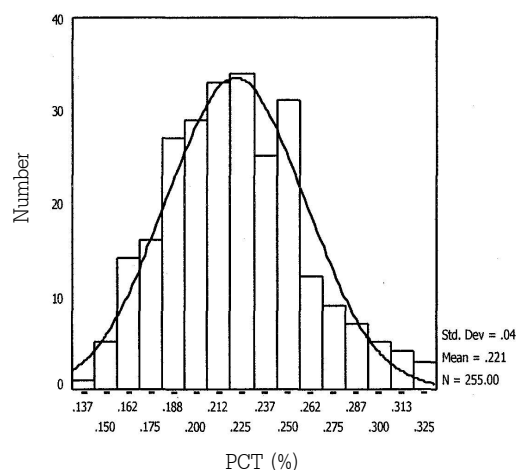


Fig. 4 Histogram of the distribution of PCT

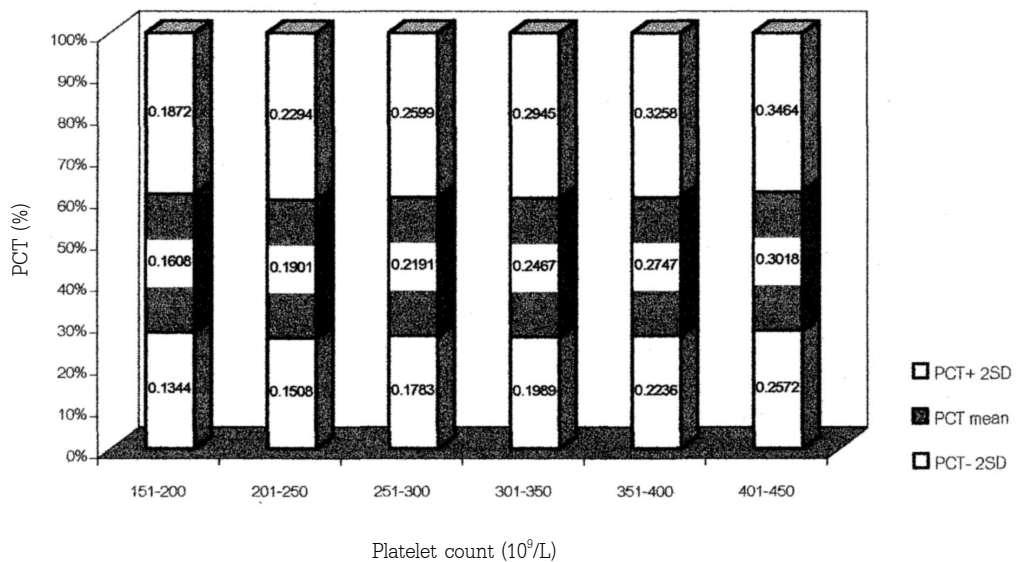


Fig. 5 Relationship between PCT and platelet count

fig. 6 PDW in male and female were significantly different (table 2) but the ranges of PDW in each of the age groups were not significantly different (table 3). When the PDW is compared as a function of platelet count (Fig 7), there was found no significant pattern.

Discussion

The automated platelet counting system has several advantages over existing counting method. The machine is relatively easy to operate and can rapidly process a large number of samples.

The platelet count of healthy males is compared to that of healthy females. A higher platelet count in women was not significantly different than that in men. Sloan (1951)¹⁶, made on a group of physiology students, where no significant sex difference was found but Stevens RF, Alexander MK (1977)¹⁷ and Bain B, Forster T

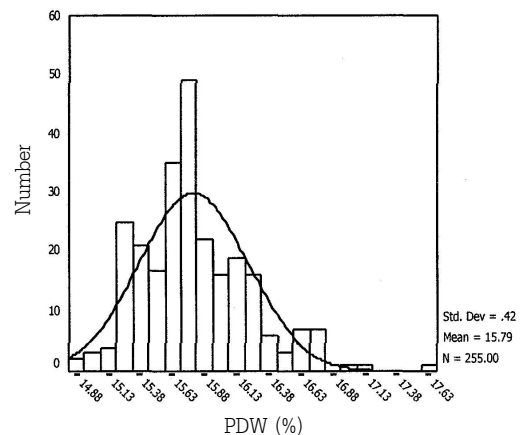


Fig. 6 Histogram of the distribution of PDW

(1980)¹⁸ found the platelet count in women higher than that in men. There have been number of investigations of possible periodic fluctuations of the platelet count during the menstrual cycle¹⁹ and the bulk of the evidence indicating a fall in the count at the onset of menstruation with the highest values occurring in mid-cycle. A variation in the platelet count of women from this

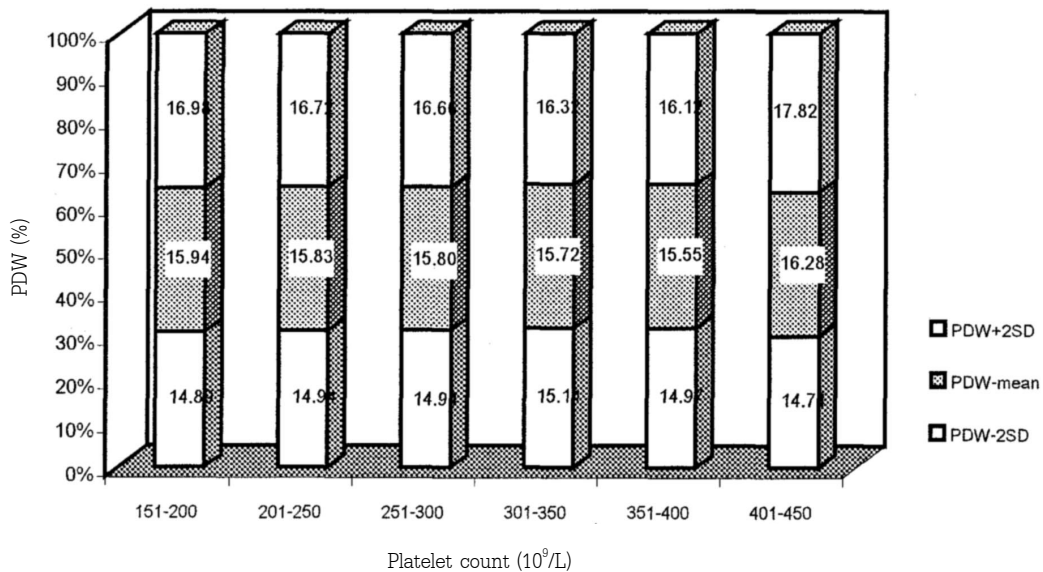


Fig. 7 Relationship between PDW and platelet count

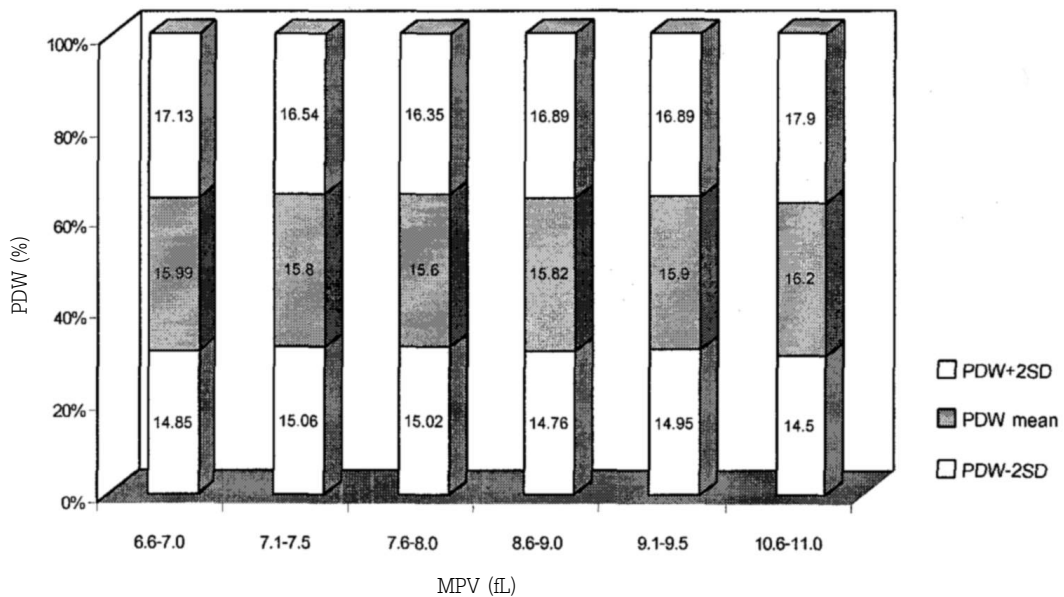


Fig. 8 Relationship between PDW and MPV

cause may provide explanation for the wider range and skewed distribution of the counts of the female donors in the present series. Platelet count seemed to vary somewhat with age.

Automated blood counts including both

platelet count and MPV are frequently the first hematologic data available to the physician¹³. The nonlinear, inverse relation between MPV and platelet count in normal subjects defines the platelet values in subjects with apparently

normal platelet production and survival. This agrees with previous findings of Granham SS.²⁰ It is known that the MPV increases as platelet half-life decrease and that large platelets are functionally different from small platelets.^{14, 21}

The PCT has been proposed as a measurement of platelet mass. PCT showed significant variation in males and females but PCT showed no significant variation over the range of ages studied. Plotting mean PCT(%) versus platelet counts between 150-450 ($\times 10^9/L$), (Fig 5), a direct, linear relationship was suggested between PCT and platelet count.

Platelet size is widely distributed in normal subjects. The platelet distribution width (PDW) increases nonlinearly as the MPV increases.(Fig 8) PDW is increased in megaloblastic or aplastic anemia, in leukemic patients receiving chemotherapy, and in chronic myeloid leukemia.¹³ The PDW may also be erroneously increased if fragmented red cells or leukocyte fragments broaden the cell distribution population. The causes of a true increased PDW are unclear, but they are believed to be related to megakaryocytic ploidy.²²

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การวิเคราะห์ค่าของเกร็ดเลือดในประชากรที่มีสุขภาพแข็งแรง โดยใช้เครื่องวิเคราะห์อัตโนมัติ

กฤษฎา ปทีปโชติวงศ์, พิสิทธิ์ ธารีรัตน์ และ วารินา อติโรจนานนท์.

ภาควิชาจุลทรรศน์ศาสตร์คลินิก คณะเทคนิคการแพทย์ มหาวิทยาลัยมหิดล โรงพยาบาลศิริราช กรุงเทพฯ 10700

บทคัดย่อ: จากการศึกษาตัวอย่างเลือดในประชากรที่มีสุขภาพแข็งแรง เพื่อดูค่าของจำนวนเกร็ดเลือด (438 ราย) ค่าเฉลี่ยของปริมาตรเกร็ดเลือด (438 ราย) เกร็ดเลือดอัดแน่น (255 ราย) และการกระจายของขนาดเกร็ดเลือด (255 ราย) พารามิเตอร์ต่างๆ ของเกร็ดเลือดเหล่านี้มีความสำคัญในการศึกษาความสัมพันธ์ของเกร็ดเลือดในงานประจำวัน เพื่อนำไปสู่การช่วยในการวินิจฉัยโรคต่างๆ และได้ศึกษาพารามิเตอร์ของเกร็ดเลือดในแง่ของเพศและอายุอีกด้วย พบว่าจำนวนเกร็ดเลือดในเพศหญิงมีมากกว่าในเพศชาย ความสัมพันธ์ของจำนวนเกร็ดเลือดและค่าเฉลี่ยของปริมาตรเกร็ดเลือดเป็นแบบ non-linear relationship เกร็ดเลือดอัดแน่นในช่วงอายุต่างๆ กันไม่มีความแตกต่างกัน และความสัมพันธ์ระหว่างเกร็ดเลือดอัดแน่นกับจำนวนเกร็ดเลือดมีความสัมพันธ์ที่ดี ($r = 0.879$) และการกระจายของขนาดเกร็ดเลือดในช่วงของอายุต่างๆ กันก็ไม่มีความแตกต่างกันเช่นเดียวกัน พารามิเตอร์ต่างๆ ของเกร็ดเลือดมีประโยชน์ช่วยในการวินิจฉัยโรคได้

Key Words : ● Platelet count ● Mean platelet volume ● Plateletcrit ● Platelet distribution width
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