Original Research Article

Platelet distribution width as a prognostic factor of outcome in hemorraghic stroke

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Abstract

Background: Hematocrits have always been helpful to doctors as they are important parameters used on a daily basis. With the latest technology one can measure different indices of platelets mainly Plateletcrit, PC, MPV, PDW.
Aim and objectives: To study the role of platelet distribution width as a prognostic factor of outcome in hemorrhagic stroke.
Materials and methods: This study included 35 patients of hemorrhagic stroke coming to MGM hospital, Kamothe.
Results: The study contained of 13 females and 22 male patients. Group A consisted of 5 patients. As the patients expired within 24 hours, only a single value of PDW was available in these patients. The mean of the PDW of these patients was 16.92 with a SD of 1.22.
Conclusion: PDW may act as a prognostic factor of mortality in hemorrhagic stroke.

Key words

Hemorrhagic stroke, Platelet Distribution Width, Platelet count, Mean Platelet Volume.

Introduction

Stroke in young adults is an important cause of lifelong disability. Thus it is very important to study the pathogenesis and prognosis of young patients with cerebral infarction [1, 2]. A hemorrhagic stroke is either a brain aneurysm burst or a weakened blood vessel leak. Blood spills into or around the brain and creates swelling and pressure, damaging cells and tissue in the brain. There are two types of hemorrhagic stroke called intracerebral and subarachnoid [3]. Intracerebral hemorrhage (ICH) accounts for approximately 10% of all strokes and causes high

morbidity and mortality. Rupture of the small perforating vessels of the cerebral arteries is caused by chronic hypertension, which induces pathologic changes in the small vessels and accounts for most cases of ICH; however, amyloid angiopathies and other secondary causes are being seen more frequently with the increasing age of the population [4]. Platelet size correlates with platelet activity and can be assessed by platelet volume indices (PVI). The PVI, mean platelet volume (MPV), is universally available with routine blood counts by automated hemograms and therefore is an attractive index to study in clinical scenarios [5]. Platelet indices were as per **Table – 1** [6].

Table - 1: Platelet indices [6].

Mean platelet volume (MPV)	Analyser-calculated measure of thrombocyte volume	femtoliters (fL)
Platelet volume distribution width (PDW)	Indicator of volume variability in platelets size	Percentage (%)
Plateletcrit (PCT)	Volume occupied by platelets in the blood	Percentage (%)
Mean platelet component (MPC)	Measure of mean refractive index of the platelets	gram/decilitre (g/dL)
Mean platelet mass (MPM)	MPM is calculated from the platelet dry mass histogram	picogram (pg)
Platelet component distribution width (PCDW)	Measure of the variation in platelet shape	gram/decilitre (g/dL)
Platelet larger cell ratio (P-LCR)	Indicator of larger (> 12 fL) circulating platelets	Percentage (%)
Immature platelet fraction (IPF)	Percentage of immature platelets	Percentage (%)

Hematological changes enable the clinician to establish an effective and early therapeutic intervention in order to prevent the occurrence of major complications in certain diseases. Platelet activation leads to changes in platelet shape with increase in MPV and PDW.

The present study analyzes only Platelet Distribution Width (PDW) as a prognostic factor of mortality in hemorrhagic stroke.

Platelet Distribution Width (PDW) is the coefficient of variation which is calculated with the same formula as for Coefficient of Variation.

$$CV = \frac{\text{Standard Deviation}}{\text{Mean}} \times 100$$

PDW = 100 x (Standard deviation of MPV) / MPV [7]

Materials and methods

The study was conducted at a Medical College of Navi Mumbai. Ethical Committee's approval was taken. Patients with hemorrhagic stroke on CT scan brain were analyzed. Those fulfilling the inclusion criteria were selected. A total of 35 consecutive patients were prospectively evaluated. Investigations were performed and blood parameters were run at the central laboratory using Sysmex Automated Hematology Analyzer XN-1000, which is an automated machine. This machine uses fluorescent radiofrequency for calculation of various platelet indices. Statistical analysis was done using SPSS software version 20.0.

Inclusion criteria

- Patients admitted with diagnosis of Acute Haemorrhagic Stroke.
- Patients whose age is above 18 years are included.

Exclusion criteria of subjects for this study included any of the situations

- Infectious disease in the previous month;
- Histories of autoimmune disorder, peripheral vascular disease, or stroke;

- Transient ischemic attack, cerebral infarction;
- Medications for lipid control, inflammation suppression,
- Immunosuppression.
- History of Drugs i.e. Aspirin OR Clopidogrel in present or recent past.
- Hemorrhagic stroke secondary to thrombolysis.
- Complication of pregnancy

Results

As charted in **Table - 2**, all the patients studied, have been classified into various groups: Group A and Group B.

Table - 2: Outcome.

	Count	**Column N %**
Died within a day (Group A)	5	14.3%
Discharged (Group B1)	11	31.4%
Died (Group B2)	19	54.3%

Table - 3: Gender Distribution.

	First Day Died		**Died**		**Discharge**		**Total**	
	No. of patient	**%**	**No. of patient**	**%**	**No. of patient**	**%**	**No. of patient**	**%**
Female	1	20.0%	7	36.8%	5	45.5%	13	37.1%
Male	4	80.0%	12	63.2%	6	54.5%	22	62.9%

Table - 4: Mean PDW of all groups.

	PDW at the time of Admission	
	Mean	**SD**
Died on First Day(Group A)	16.92	1.22
Discharged (Group B1)	9.04	1.31
Dead (Group B2)	13.93	2.15

Mean PDW at time of admission

	Mean	**SD**
Overall mean of patients with 2 or more PDW values(Group B)	12.13	3.03

Table - 5: Mean PDW of patients at time of admission (Group B1).

Mean PDW at time of admission and discharge compared

	Mean	**N**	**Std. Deviation**
PDW Admission	9.0364	11	1.31093
PDW on day of discharge	9.5273	11	1.6426

Paired t-test result:

t-test	**df**	**p-value**
-2.243	10	0.049

Interpretation: Since p-value for the t-test was 0.049 indicates significant (Borderline significance) increase in the PDW at the time of discharged.

Table - 6: Mean comparison of PDW of dead patients at time of admission and discharge (GroupB2).
Mean PDW at the time of admission and death compared

	Mean	N	Std. Deviation
PDW Admission	13.9263	19	2.14938
PDW on day of death	14.7684	19	1.6142

Paired t-test result:

t-test	df	p-value
-3.608	18	0.002

Interpretation: Since p-value for the t-test was 0.002 indicates significant increase in the PDW at the time of death.

Table - 7: Comparison of Mean PDW between Discharged (Group B1) and Died (Group B2) at the time of Outcome.
Comparison of mean PDW between discharged (group B1) and died (group B2) at the time of outcome

Outcome	N	Mean	Std. Deviation	Std. Error Mean
Dead	19	14.7684	1.61419	.37032
Discharged	11	9.5273	1.64261	.49527

Independent t-test:

t-test	df	p-value	Mean Difference
8.516	28	.000	5.2412

Interpretation: Since p-value for the independent t-test was less than that of 0.00 indicates that the PDW was significantly higher at the time of death when compared against discharged.

Table - 8: ANOVA test.
Findings of ANOVA test

	Sum of Squares	df	Mean Square	F	p-value
Between Groups	204.931	2	102.466	30.014	.000
Within Groups	157.040	46	3.414		
Total	361.971	48			

Multiple comparison test
Findings of Multiple comparison test

(I) pt live/dead	(J) pt live/dead	Mean Difference (I-J)	Std. Error	Sig.	Interpretation
Died on First Day (Group A)	Discharged (Group B1)	4.39904*	.70002	.000	Significantly more in died on first day
Died on First Day (Group A)	Dead (Group B2)	-.84211	.59947	.347	Insignificant
Dead (Group B2)	Discharged (Group B1)	5.24115*	.70002	.000	Significantly more in died cases

Table - 9: Percentage change in PDW in Group B (Discharged + Dead)
Basic data Distribution

	Dead		**Live**	
PDW Change in percentage	**Increased**	**Decreased**	**Increased**	**Decreased**
0-5	1	1	4	1
5.1to 10	7	3	3	1
10.1 to 15	4	0	0	0
15.1 to 20	3	0	2	0

The study contained of 13 females and 22 male patients and their contribution has been categorized in **Table - 3**.

Group A consisted of 5 patients. As the patients expired within 24 hours, only a single value of PDW was available in these patients. The mean of the PDW of these patients was 16.92 with a SD of 1.22 (**Table - 4**).

Group B patients consisted of 30 patients. We had two values of the PDW of these patients: One at the time of admission and the other at the time of outcome. They were divided into two groups. Of the 30 patients, 11 survived (Group B1) and 19 expired (Group B2). The mean of the entire 30 patients PDW on admission was 12.13. The mean PDW of Group B at the time of the endpoint was 12.84667 with SD of 3.0243. Group B1: The mean PDW at the time of admission was 9.04 and SD 1.31. The mean PDW at the time of end point was 9.52 with a SD of 1.6426 (**Table - 5**).

Group B2: The mean PDW at the time of admission was 13.93 with a SD 2.15. The mean of these patients PDW at the terminal point was 14.768 with a SD of 1.614 (**Table - 6**).

The PDW of B2 group with B1 Group: it was observed that the PDW was statistically higher in group B2 (.000) (**Table - 7**).

The PDW of Group A patients was statistically significantly more than that in Group B1 (.000) and Group B2 (.007) (**Table - 8**).

Table - 9 shows the deviation of various mean values of all group and thus helps in landing with a conclusion.

It was observed that the patients, who expired at the time of admission, had a higher baseline PDW i.e.13.93 than the survivors, which were 9.04. However among the survivors (Group B1) the PDW at the time of end point was 9.52 with a SD of 1.64. Among the dead patients (Group B2) the PDW at the terminal point was 14.768 with a SD of 1.614.

The increment in PDW in the expired patients was statistically significant as compared to the increment in the PDW value of the discharged patients (**Table - 8**).

The entire 5 patients of Group A, have a baseline PDW more than 12.13 which has a positive correlation with PDW at endpoint of the patients who expired.
To postulate → If the baseline PDW is more than 12.13 on presentation there is an increased chance of mortality. Again if the PDW is increased by 10% there is likelihood of mortality. So PDW may act as prognostic factor of mortality in patients with hemorrhagic CVA.

Discussion

Like various other blood indices, platelet indices are nowadays catching eyes of the physicians and pathologists in predicting the outcomes of various diseases. PDW and MPV are 2 indicators of platelet, which reflect the size and variability, respectively [8]. Though they are contraindicated

sometimes in diseases which have pathological change in shape, size or numbers of platelets but other indices like IPF are even helpful in those diseases [9]. Earlier parameters like RDW have been proven to show the prevalence of sepsis. Various studies are being conducted throughout the world and in the upcoming decade platelet indices promises to play a significant role in various hematological or non-hematological diseases. A study conducted in Beijing, China reflected the association of platelet indices with blood pressure in adults [10]. Even studies have been conducted on camels and other animals to prove the significance of platelet indices and have ended with a positive conclusion [11]. Red cell distribution width is also higher in patients with stroke compared with those without. However, there is no data available on the association of red cell distribution width, assessed during the acute phase of ischemic stroke, with stroke severity and functional outcome. Study conducted by Ntaios G., Gurer O., Faouzi M., Aubert C., Michel P. concluded that the Red cell distribution width, assessed during the early phase of acute ischemic stroke, does not predict severity or functional outcome [12]. The prognosis for Intra Cerebral Hemorrhage (ICH) patients with Chronic Kidney Disease (CKD) is dismal and overall mortality rates have been reported to range from 43.8% to 83%. The study conducted by Lee S. H., Park K. J., Kang S. H., Jung Y. G., Park J. Y., Park D. H. showed an overall mortality rate of 34.4%, which is better than rates reported in other studies [13].

In our study out of the 30 patient increase in PDW by 10% or more was seen in total 9 patients out of which 7 died and 2 survived. Out of the patients who survived, had baseline value less than 12.13(mean PDW of all patients). The decrease in PDW in alive and dead patients was compared. There was no significant difference observed.

The present study helps in predicting mortality of patients with hemorrhagic stroke as it was evident that if the baseline PDW is more than 12.13 initially, there is an increased chance of mortality and if there is further increase in PDW by 10 %, the chances of mortality are more. Also, with the advancement of technology PDW may serve as one of the important prognostic factor in predicting mortality in various other diseases also.

Conclusion

There is paucity of literature on PDW in hemorrhagic stroke. Though recent advances in technology have made it possible to record various platelet indices with automated hematology analyzer, still there is a long way to go. Present study concluded that an increment of PDW by 10% over baseline or more may be an indicator of mortality in hemorrhagic stroke patients.

Study limitations

It is a cross sectional prospective study with a small sample size. The total number of 35 patients provided less probability and prediction, if the same study is carried out on a large scale or multi tertiary centers, it may prove more relevant and important.

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