



MEAN PLATELET VOLUME: A MEASURE OF PLATELET ACTIVITY AND ITS RELATION WITH OTHER PLATELET INDICES IN DEEP VEIN THROMBOSIS

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ABSTRACT

Several parameters may help in identification of DVT. Several studies proposed that larger mean platelet volume (MPV) is an indicator of increased in vivo platelet activation. The MPV correlates with platelet activity whether measured as aggregation, thromboxane A₂ (TXA₂) or 3-thromboglobulin (β-TG) release, or adhesion molecule expression. A total number of 33 cases and 33 controls were included in this study. We included all patients who were positive for acute DVT as confirmed by Duplex scan. Patients on antiplatelet/anticoagulant therapy were excluded from the study. Clinical assessment of all patients, detailed history and physical examination was performed and recorded in proforma. 2ml of blood collected in lavender top vials containing K2EDTA and analyzed in Beckmann Coulter fully automatic analyzer. Mean of MPV of all cases was 9.9fL and mean of MPV of all controls was 9.1fL. MPV was found to be raised in cases when compared to controls which was statistically significant with p-value=0.004. Mean platelet volume is a marker of platelet activation and is raised in DVT patients when compared to healthy individuals.

Keywords: DVT, Platelets, Mean Platelet Volume (MPV)

1. INTRODUCTION

Deep-vein thrombosis (DVT) has an estimated annual incidence of 67 per 100000 among the general population. Deep venous thrombosis is a serious disease not only because of the risk of developing pulmonary embolism, but also of its risk for long term sequelae. Venous thromboembolism comprises DVT and/or pulmonary embolism and either of them can be asymptomatic [1].

Compression ultrasonography is now the imaging test of choice to diagnose DVT. Lack of compressibility of a venous segment is the diagnostic criterion used, but the addition of Doppler (including color flow) can be useful to accurately identify vessels and to confirm the compressibility of a particular segment [2].

Platelets play a key role in hemostasis, which is the cessation of bleeding. Platelets are also important for thrombosis, which is the pathological formation of occlusive thrombi in the vessels. Under normal conditions, platelets circulate in a “resting” state. Upon damage to the endothelial cell surface or disruption of

endothelial monolayers, platelets are exposed to the underlying subendothelial matrix. Activated platelets release their granule contents, amplifying the recruitment of other platelets and resulting in platelet aggregation.

Several studies proposed that larger mean platelet volume (MPV) is an indicator of increased in vivo platelet activation. The MPV correlates with platelet activity whether measured as aggregation, thromboxane A₂ (TXA₂) or 3-thromboglobulin (β-TG) release, or adhesion molecule expression. Notably, larger platelets are haemostatically more reactive and prone to the development of thrombosis than platelets of normal size [3].

2. MATERIAL AND METHODS

A total number of 33 cases and 33 controls were included in this study. We included all patients who were positive for acute DVT as confirmed by Duplex scan. Patients on antiplatelet/anticoagulant therapy were excluded from the study. Clinical assessment of all patients, detailed

history and physical examination was performed and recorded in proforma. 2ml of blood collected in lavender top vials containing K2EDTA and analyzed in Beckmann Coulter fully automatic analyzer.

3. RESULTS

Out of 33 patients, 16 patients were male and 17 were female. Majority of patients (16 out of 33, 48.4%) belong to middle age group between 20-40 years. Majority of patients, 30 out of 33 presented with the complaint of pain in limb and 25 out of 33 presented with the complaint of swelling in limb. 22 out of 33 presented with the complaint of both swelling and pain. Tenderness (30/33) was the most common sign, followed by calf swelling (27/33) as the 2nd most common. Lower limb was involved in almost all cases (32/33). 27 out of 33 patients had proximal DVT and 5 out of 33 patients had distal DVT. 28 out of 33 were provoked DVT and 5 were unprovoked showing immobilization (21/33) as the most common precipitating factor among all DVT patients. IV drug use was the 2nd most common precipitating factor. When compared with clinical scores, 30 out of 33 had Wells score >2 and 17 out of 33 had Caprini score ≥5.

Table 1: Distribution according to MPV (Mean platelet volume)

MPV (fL)	Number of cases
<10	19
≥10	14

Table 2: Comparison of MPV between case and control

	Mean±SD Case	Mean±SD Control	t-value	p-value
Age	41.27±13.510	43.76±8.058	-0.907	0.368
MPV	9.952±1.2533	9.1450±0.9434	2.952	0.004

Table 3: Comparison of clinical score and platelet indices of DVT patients with MPV<9.25fL and MPV>9.25fL

	MPV <9.25 (Mean±SD)	MPV >9.25 (Mean±SD)	t-value	p-value
Age	41.31±17.708	41.25±10.457	0.012	0.991
TLC	9.752±4.2378	12.958±6.5656	-1.558	0.129
Plt count	309.62±79.121	226.60±107.712	2.386	0.023
RDW	63.338±16.9893	54.280±13.2529	1.717	0.096
PDW	16.392±0.8311	16.665±0.6604	-1.047	0.303
PCT	0.227±0.0752	0.206±0.0900	0.688	0.497
P-LCC	85.38±18.737	80.40±39.487	0.423	0.675
P-LCR	37.554±8.0754	43.165±7.7579	-1.998	0.055
Wells score	4.38±1.193	4.70±1.559	-0.620	0.540
Caprini score	4.85±3.105	4.55±2.417	0.307	0.761

Table 1 shows that majority of patients (19/33) had MPV <10fL. Normal value of MPV is 7.5-11.5fL.

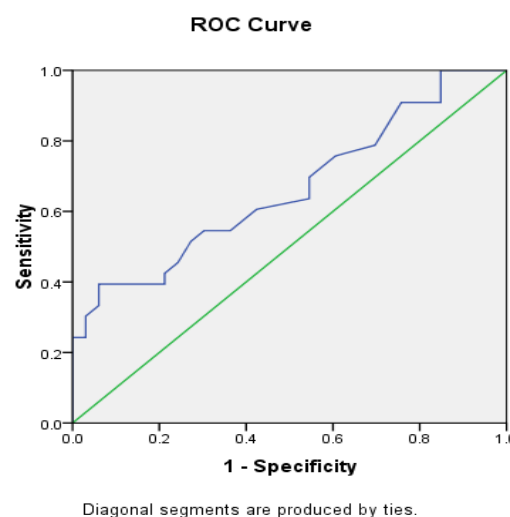


Fig.1: Receiver operating curve analysis was applied to identify DVT patients on the basis of MPV.

Cut-off value for MPV was 9.25fL with area under curve: 0.664, sensitivity was 60.6%, and specificity was 58.0% for patients with DVT (p-value=0.022). Green line; reference line.

MPV

Area under curve (AUC)	:	0.664
p-value	:	0.022
Cutoff Value	:	9.25
Sensitivity	:	60.6%
Specificity	:	58.0%

Table 3: Cut-off for MPV calculated from ROC and divided in two groups, one having MPV less than cut-off and other having more than the cut-off. All laboratory characteristics compared with these two groups. Student t-test was applied for comparison.

Mean of platelet count in patients having MPV<9.25fL was $309.62 \times 10^3/\mu\text{L}$ and mean of platelet count in patients having MPV>9.25 was $226.60 \times 10^3/\mu\text{L}$. Platelet

count was raised in DVT patients having MPV<9.25fL when compared with MPV>9.25fL, with p-value=0.023.

RDW, PCT, P-LCC and Caprini score was high in patients with MPV<9.25fL and TLC, PDW, P-LCR and Wells score was high in patients with MPV>9.25fL, but results were insignificant.

Table 4: Comparison of MPV with CAPRINI score

	Caprini score 0-1	Caprini score 2	Caprini score 3-4	Caprini score ≥5	F-value	p-value
MPV	10.600±1.3241	9.875±1.3451	9.825±1.4069	9.876±1.2194	0.386	0.764

Table 4: One way ANOVA test was applied to compare MPV with Caprini score but no significant relation obtained.

Table 5: Comparison of MPV with Wells score

	Wells score ≤2	Wells score >2	t-value	p-value
MPV	10.000±1.3000	9.947±1.2714	0.069	0.945

Table 5 showing comparison of MPV with Wells score by student t-test but no significant relation obtained

Table 6: Comparison of MPV with Proximal and Distal DVT

	Proximal DVT (n=27)	Distal DVT (n=5)	t-value	p-value
MPV	9.815±1.2685	10.160±0.4159	-0.595	0.556

Table 6: Student t-test applied to compare MPV with proximal and distal type of DVT but no significant relation obtained.

4. DISCUSSION

Mean platelet volume (MPV) is a blood parameter commonly used in determining thrombocyte size, which yields result in a short time, has a low cost, and can be detected in routine blood tests⁴. The MPV reflects the size of the thrombocytes, and it is accepted as a marker in determining thrombocyte function. Large platelets, when compared to smaller platelets, are enzymatically and metabolically more active and have more prothrombotic potential. A rise in MPV level increases platelet aggregation, thromboxane synthesis, β -thromboglobulin secretion, and expression of adhesion molecules. Increased MPV in cardiovascular disease is associated with high mortality and is considered an important risk factor and there have been several reports that DVT also relates to increased MPV [4, 5].

In a study by Gulcan et al (2012), MPV levels in patients with newly diagnosed acute DVT (n=52) was investigated and age, gender, and body mass index matched control group consisted of 30 healthy volunteers was compared [6]. They have found that MPV was significantly higher among patients with DVT when

compared with the control group (8.6 ± 0.8 fL vs. 7.7 ± 0.9 fL, respectively; $p < 0.001$).

Atila Icli et al (2015), evaluated relation between MPV and pulmonary embolism in DVT patients. The study included three groups: patients with DVT and PE (n=98); patients with DVT without PE (n=97); and control group (No DVT, No PE, n=98). They compared various clinical and laboratory characteristics with three groups [7]. Mean platelet volume values were significantly higher in DVT patients with and without PE than controls (9.9 ± 0.6 fL and 8.7 ± 0.7 fL vs 7.9 ± 0.7 fL respectively, $p < 0.001$ for both). The ROC analysis to identify the presence of PE showed an area under the curve of 0.93, $p < 0.001$ and a cut-off value for MPV of 9.15 fL. The sensitivity, specificity, positive and negative predictive values were calculated as 86, 82, 75, and 59%, respectively. They divided all cases on the basis of this cut-off i.e. two groups, one having MPV<9.15fL and other having MPV>9.15fL. They compared all clinical and laboratory characteristics with these two groups and found that TLC was raised in second group ($9.2 \pm 2.8 \times 10^3$ cells/ μL vs $9.6 \pm 3.2 \times 10^3$ cells/ μL ; $p=0.35$). Platelet count was significantly raised in group with MPV<9.15fL

when compared with $MPV > 9.15 \text{ fL}$ ($263 \pm 70.3 \times 10^3 \text{ cells}/\mu\text{L}$ vs $235 \pm 70.4 \times 10^3 \text{ cells}/\mu\text{L}$; $p=0.007$).

In our study, we compared MPV between 33 cases and 33 controls. MPV was significantly raised in cases as compared to controls ($9.95 \pm 1.2 \text{ fL}$ vs $9.14 \pm 0.9 \text{ fL}$; $p=0.004$). We applied ROC analysis for MPV, to identify the presence of DVT. For MPV, area under curve was 0.664, $p=0.022$ and a cut off value of 9.25 fL . The sensitivity was 60.6% and specificity was 58.0%. In addition, we divided cases in two groups: one having $MPV < 9.25 \text{ fL}$ and other having $MPV > 9.25 \text{ fL}$ and compared all platelet indices to both of these two groups. Platelet count was significantly raised in group having $MPV < 9.25 \text{ fL}$ when compared with group having $MPV > 9.25 \text{ fL}$ ($309.6 \pm 79.1 \times 10^3/\mu\text{L}$ vs $226.6 \pm 107.7 \times 10^3/\mu\text{L}$, $p=0.023$). It clearly meant that on having cut off as 9.25 fL for MPV, the sensitivity of this test to identify DVT patients is 60% and specificity is 58% and platelet count is significantly raised in patients having $MPV < 9.25 \text{ fL}$. Rest of the platelet indices were also compared but none of the comparison was significant.

5. CONCLUSION

Mean platelet volume is a marker of platelet activation and is raised in DVT patients when compared to healthy individuals.

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