



## Original Research Article

## Mean platelet volume: Has it the capacity to predict the concentration of Platelet counts in Dengue: A study

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## ABSTRACT

**Background:** Dengue, endemic in India presents in mild to severe forms with or without bleeding. There is no specific treatment available till date hence severe dengue has to be recognized in early stages. Platelet counts are unreliable as they do not correlate with bleeding. Platelet indices have been studied for their utility as predictors of severity of the disease and aid in guide to transfusion therapy. Mean platelet volume is inexpensive and available with routine complete blood counts in hematology analyser. Its role as marker in diagnosis, prognosis and treatment of dengue has been investigated with platelet indices reports.

**Aims:** To study MPV patterns, association with platelet counts and relevant laboratory parameters in dengue.

**Methods:** The study was conducted over one month in the year 2016 in department of Hematology, Kempegowda Institute of Medical Sciences Hospital, Bengaluru. 100 serologically proven dengue cases were analysed with data collected from the records in the departments of Hematology and Microbiology against patient's unique hospital identification number.

**Results:** There was a predominance of young male patients. The range for MPV was 8.7 – 13.2 (average 10.95) with 35% normal and 65% high MPV cases. There was 48% cases with moderately severe / severe thrombocytopenia, 32% with increased hematocrit, 35% with leucopenia, 54% with significant atypical lymphocytosis and 42% with antibody pattern. There was an increased number of high MPV seen in severe thrombocytopenia, increased hematocrit significant atypical lymphocytosis and antibody pattern whereas normal pattern was noted in leucopenia.

**Conclusion:** High MPV is a useful predictor of severe dengue platelet recovery and may guide in transfusion therapy.

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### 1. Introduction

Dengue of serious public health concern in India caused by DENV, manifests as asymptomatic mild or severe dengue with haemorrhage and shock.<sup>1</sup> Thrombocytopenia is one of the criteria to indicate the clinical severity and also contributes to bleeding. Platelet counts may or may not directly correlate with haemorrhagic manifestations.<sup>1–5</sup> Platelet counts decrease from the 3<sup>rd</sup> to 7<sup>th</sup> day

and usually normalizes by the 8<sup>th</sup> to 10<sup>th</sup> day of fever. Thrombocytopenia is caused by the bone marrow suppression by the virus, increased peripheral destruction or increased consumption / abnormal pooling of platelets.<sup>6,7</sup> Management dilemmas occur with severe thrombocytopenia due to risk of haemorrhage / bleeding leading to unwarranted, unsafe, excess and expensive transfusions.<sup>8–10</sup>

A 'wait and watch' restrictive transfusion policy is beneficial. Laboratory tests like Platelet indices which aid in patient management have been investigated. Mean Platelet Volume (MPV) the volume of platelets measured in

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femtolitres (fl) is a predictor of platelet recovery, etiology of thrombocytopenia (hypoproliferative or rapidly responding bone marrow), worsening dengue and impacts therapy.<sup>1,6,10</sup>

## 2. Aims and Objectives

Our study investigated the association of MPV with

1. Platelet count and relevant laboratory parameters
2. Its patterns in Dengue.

## 3. Materials and Methods

This study included 100 serologically proven dengue cases at department of Haematology, Kempe Gowda Institute of medical sciences hospital, Bengaluru over a period of one month in the year 2016.

The Hematology data obtained by the Hematology Analyser Sysmex 1800i retrieved from the hematology records and the Dengue serology from the microbiology department records was tabulated. Platelet and Differential counts was checked on peripheral smear stained with Lishman stain as per the hospital protocol for confirmation of counts. All data was analysed.

### 3.1. Inclusion criteria

All serologically proven cases of Dengue with thrombocytopenia and complete hemogram data.

### 3.2. Exclusion criteria

Cases of Dengue with associated diseases, normal and increased platelet counts and without relevant lab data.

### 3.3. Ethical committee clearance

The patient data was analysed against unique hospital identification number and anonymity maintained. The study was approved by the Ethical committee of hospital.

## 4. Results

Our study showed an age range from 9 months to 65 years with a male to female ratio of 1.3:1 (Table 1).

The analysis of MPV patterns showed a range from 8.7 to 13.2 fl with an average of 10.95 fl. The normal MPV range for the study was 7.5 to 10.5 fl.

We had 35% to 65% of cases with normal and increased MPV respectively (Table 2).

Thrombocytopenia was graded as

- 1) Mild : 0.76 – 1.49 l/cumm in 28% of cases
- 2) Moderate : 0.51- 0.75 l/cumm in 24% cases
- 3) Moderately Severe : 0.26 – 0.50 l/cumm in 32% cases
- 4) Severe : < 0.25 l/cumm in 16% cases.

MPV association with Thrombocytopenia (Table 3)

Normal MPV was noted in 12/35 (34%) as against 36/65 (55%) with increased MPV in moderately severe thrombocytopenia. Normal MPV was seen in 6/16 (38%) as against 10/16 (62%) of high MPV cases in counts < 0.25 l/cumm. As the platelet counts increased, the proportion of both became approximately equal.

MPV with hematocrit (Table 4) showed 32% with hematocrit greater than 45, of which 69% had high and 31% had normal MPV. Analysing MPVs 22/65 (34%) of increased and 10/35 (28%) of normal MPV had high hematocrit.

MPV with Leucopenia (Table 5) showed 35% with Leucopenia, 55% with normal counts and 10% with Leucocytosis.

20/65 (31%) of increased as against 15/35 (43%) of normal MPV had leucopenia.

The Atypical Lymphocytosis is significant if >20% lymphocytes were found to be of atypical type. Of the 54 cases, there were 40/54 (74%) with significant increased atypical lymphocytosis as against 14/54 (26%) with normal MPV. Analysing MPV, 14/35 (40%) normal as against 40/65 (62%) with high MPV showed significant Atypical lymphocytosis.

We had 15/35 (43%) of normal cases as 15/65 (25%) of high MPV with NS1 antigen pattern. Antibody association was noted in 30/65 (46%) of high as against 12/35 (34%) of normal MPV. The distribution of NS1 antigen was equal between normal and high MPV but antibody pattern showed a predominance of high MPV.

## 5. Discussion

Platelet indices have been the focus of interest for their utility in Dengue.<sup>11</sup> The tests are simple, inexpensive and non invasive.<sup>10,12–16</sup> MPV is an indicator of platelet size and is reported as a ratio of Plateletcrit to total platelet count in Hematology Analyser by different methods like Impedence, optical light scatter counting etc.<sup>10,11,16,17</sup> Normal MPV range for our study is 7.5 – 10.5 fl<sup>13,16</sup> but differ in other due to many variables.<sup>11,14,16–18</sup> In healthy individuals, MPV correlates inversely with platelet counts but the proportions differ in pathologic states.<sup>17</sup>

MPV is indicative of platelet turnover and is increased with rapid marrow response and it decreases with hypoproliferative states in Dengue with thrombocytopenia<sup>6,10,12,19</sup> because

1. The younger platelets are larger in size and the newly formed cells contain more granules.
2. Activated platelets change shape from biconcave to spheroidal with pseudopod formation.
3. In hypoproliferative states only aged, small platelets remain in circulation.<sup>10,13–16,18–21</sup>

MPV correlates with platelet activation and recovery indicating the etiology of thrombocytopenia

**Table 1:** Age and sex pattern

Age				Sex				Total
>12 years (Adults)		< 12 years (Pediatric)		Male		Female		
n	%	N	%	n	%	n	%	
71	71	29	2	57	57	43	43	100

**Table 2:** MPV (fl) patterns

MPV Range	N	%
< 7.5	Normal	Normal
7.5 – 10.5	35	35
10.6 – 11.5	44	44
11.6 – 12.5	16	16
>12.6	05	05
Total	100	100

**Table 3:** MPV & Platelet counts

MPV	< 0.25		0.26 – 0.5		0.5 – 0.75		0.76 – 1.5		Total
	n	%	n	%	n	%	n	%	
< 7.5									
7.5 – 10.5	06	17	06	17	12	34	11	32	35
10.6 – 11.5	07	16	17	39	07	16	13	29	44
11.6 – 12.5	02	12	08	50	03	19	03	19	16
>12.6	01	20	01	20	02	40	01	20	05
Total	16		32		24				100

**Table 4:** MPV and Hematocrit

MPV (fl)	Hematocrit				Total
	< 45 %		>45 %		
	N	%	n	%	
7.5 – 10.5	25	71	10	29	35
>10.6	43	66	22	34	65
Total	68		32		

**Table 5:** MPV with total white cell count (cells / cumm)

MPV (fl)	Normal (4000 -11000)		Leucopenia (< 4000)		Leucocytosis (> 11000)		Total
	n	%	n	%	n	%	
7.5- 10.5	19	54	15	4	01	03	35
>10.6	36	55	20	31	09	14	65
Total	55		35		10		100

**Table 6:** Atypical Lymphocytosis

MPV (fl)	< 20 %		>20 %		Total
	n	%	n	%	
7.5 – 10.5	21	60	14	40	35
>10.6	25	38	40	62	65
Total	46		54		100

**Table 7:** MPV with Serology

MPV (fl)	NS 1 pattern		Mixed		Antibody Pattern		Total
	N	%	N	%	n	%	
7.5 – 10.5	15	43	08	23	12	34	35
>10.6	15	25	20	31	30	46	65
Total	30		28		42		100

(hyperdestructive due to peripheral destruction of platelets with rapid marrow turnover or hypoproliferative due to marrow suppression by virus) and impacts prognosis and treatment.<sup>6,11–13,15,16</sup>

Our study shows a predominance of younger aged and male patients in accordance with the other studies.<sup>13,15,22</sup>

MPV patterns showed a range of 8.7 – 13.2 but differed in others.<sup>6,13,15,21,23</sup> The average MPV was in accordance with few studies like Basher et al & Pritam Sewakdar et al<sup>6,10,14</sup> but varied in others like Gogaram et al<sup>19,24,25</sup> MPV patterns were similar to the study by Ishito et al. thrombocytopenia patterns were in accordance with the same<sup>3</sup> but varied in others.<sup>2,4</sup>

Our study showed a high MPV in increased proportion of thrombocytopenia cases in accordance with few<sup>24,25</sup> but differed in others<sup>21</sup> we had a predominance of high MPV associated with severe thrombocytopenia and high hematocrit as per the WHO criteria for severe dengue. Increased hematocrit is attributed to the endothelial damage by cytokines which also cause platelet activation, increased size and MPV.<sup>26,27</sup> We had 34% of high MPV in association with increased hematocrit and 60% cases with platelet count less than one lakh in accordance with study of K. Sharma et al with high MPV in 38.8% Dengue shock syndrome and 56.5% of Dengue haemorrhagic fever cases respectively. There was increased proportion of high MPV cases with significant atypical lymphocytosis which is a bad prognostic indicator according to studies.<sup>28</sup>

Our study had a lower proportion of high MPV cases with leucopenia similar to study by U Ralpanowa et al<sup>29</sup> which attribute to prognostic relevance or claim good prognosis for leucopenia.<sup>29</sup>

Our study is in concordance with four studies by S R Dewi et al and Manoharan A et al, which claim an association of high MPV with severe Dengue<sup>24,30</sup> however other studies differ.<sup>15,21–23</sup>

We had significant number of high MPV cases in association with antibody pattern. In Dengue, IgM levels rise at 3–5 days of fever and IgG at 6–15 days.<sup>31,32</sup> This coincides with the time of platelet activation and recovery around 8 – 10<sup>th</sup> day.<sup>6,7</sup> Our study is in concordance with several studies which associate high MPV with platelet activation and recovery.<sup>12,15,23,24</sup>

## 6. Limitations of the Study

The study was limited by lack of

1. Standardization of MPV.
2. Baseline and serial monitoring of MPV in association with other tests.
3. Studies along with similar lines to compare data with clinical correlation.
4. Small sample size.
5. Inclusion of other platelet indices which could increase sensitivity and specificity.

## 7. Conclusion

Platelet indices have been investigated for their utility in Dengue. Our study on MPV suggests that it could be used as a predictor of severe dengue due to significant association with other prognostic predictors like hematocrit, thrombocytopenia and atypical lymphocytosis. A high MPV is suggestive of platelet activation and recovery and thus can impact transfusion therapy.

## 8. Source of Funding

None.

## 9. Conflict of Interest

None.

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