

## A STUDY ON MEAN PLATELET VOLUME AND SEVERITY OF PERIPHERAL ARTERIAL OCCLUSIVE DISEASE

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### Abstract

**Background:** Peripheral artery disease (PAD) is a disorder that causes aortic occlusion with atherosclerosis being the most common cause. The disease is classified according to various scores and is influenced by platelet activity. This study used the Fontaine classification to analyse the association between the mean platelet volume and peripheral arterial occlusive disease severity. **Materials and Methods:** This cross-sectional study was conducted on 60 consecutive patients admitted to Government Rajaji Hospital & Madurai Medical College for six months from March 2018 to August 2018. Data collection included patient history and a general examination. Laboratory investigations included complete blood count with ESR, mean platelet volume, renal function test, fasting and postprandial blood glucose, ABPI Measurement, and Doppler scan. **Result:** Among the 60 patients, 43 were male and 17 were female. The mean age of the patients was 56 years, and 65% belonged to the 30-59 age group. There were no significant differences in age, Hb, MCV, or platelet count between the Fontaine classifications. A significant difference was observed in ABPI between the Fontaine classification systems. A significant association was observed between the mean platelet volume and the severity of PAOD according to the Fontaine classification, with a p-value of <0.001. There were no significant differences in sex, CAD, CVD, antiplatelet drugs, Tobacco, Alcohol, and Hypertension between the mean platelet volumes. **Conclusion:** MPV predicts vascular event severity with larger platelets containing more active molecules. Patients with larger MPV should be aggressively treated to prevent disease progression.

## INTRODUCTION

Peripheral artery disease (PAD) is a disorder in which occlusion of the aorta or its branches occurs.<sup>[1]</sup> Atherosclerosis is the most common cause of PAD in patients > 40 years of age. Other than atherosclerosis, other causes include thrombosis, embolism, vasculitis, fibromuscular dysplasia, entrapment, cystic adventitial disease, and trauma. The highest prevalence occurs in the sixth and seventh decades of life.<sup>[2,3]</sup> In patients with atherosclerosis of CAD and CVA, there is an increased risk of developing PAOD in cigarette smokers and individuals with diabetes mellitus, hypercholesterolaemia, hypertension, or renal failure. The pathology of the lesions includes atherosclerotic plaques with calcium deposition, thinning of the media, patchy destruction of the muscle and elastic fibres, fragmentation of the internal elastic lamina, and thrombi composed of platelets and fibrin.<sup>[4,5]</sup>

The clinical severity of PAD is classified by various classifications and scores, namely the Fontaine classification, Rutherford classification, Bollinger Angiographic classification, and Graziani morphological categorisation. An objective assessment of the presence and severity of the disease can be performed using noninvasive techniques. Arterial pressure can be recorded noninvasively in the legs by placing sphygmomanometric cuffs at the ankles and using a Doppler device to auscultate or record the blood flow from the dorsalis pedis and posterior tibial arteries. Routine Doppler and ABPI measurements may be spuriously elevated in diabetic patients and those with renal failure, as these patients may have heavily calcified vessels.<sup>[6,7]</sup>

Platelets play pivotal roles in the pathogenesis of atherosclerosis and PAD. MPV, a measure of platelet size, is increasingly being recognised as an important marker of platelet activity. Larger platelets are metabolically and enzymatically more active and have higher thrombotic potential and expression of

platelet surface activation markers. Large platelets contain more prothrombotic material and are more likely to aggregate than small platelets. Platelet volume increases in patients with myocardial infarction and cerebrovascular disease, but data on peripheral artery disease (PAD) are lacking.<sup>[8-11]</sup> Hence, this study used the Fontaine classification to analyse the association between mean platelet volume and peripheral arterial occlusive disease severity.

## MATERIALS AND METHODS

This cross-sectional study was conducted on 60 consecutive patients admitted to Government Rajaji Hospital & Madurai Medical College for six months from March 2018 to August 2018.

### Inclusion Criteria

All new cases of peripheral arterial disease confirmed by Doppler ultrasonography and ABPI (<0.9) admitted during the study period were included.

### Exclusion Criteria

Patients with diabetes mellitus, chronic kidney disease, septicaemia, known coagulation disorders, known haematologic disorders, or vasculitis were excluded from the study.

Data collection included patient history and a general examination. Laboratory investigations included

complete blood count with ESR, mean platelet volume, renal function test, fasting and postprandial blood glucose, ABPI Measurement, and Doppler scan.

## RESULTS

Among the 60 patients, 43 were male and 17 were female. Among the males, 21(49%) fell into Fontaine Class 1 and 2 disease, and 22(51%) had Class 3 and 4 diseases compared to females in whom 7 (41%) had less severe diseases Fontaine Class 1 & 2 and 10 (59%) had more severe disease fitting into Fontaine Class 3 & 4. The mean age was 56 years, 65% belonged to the 30-59 age group, 33% fell into the 60-89 age group, and only one was above 90 years.

The mean platelet count was 2.53 lac/mm<sup>3</sup> in the study population. The mean haemoglobin level was 11.228 g%, and MCV was 83.85± 9.064 fL. The ankle-brachial pressure index ranged from 0.4, the lowest measurement, to 0.9, the highest recorded ABPI, with a mean of 0.76 [Table 1].

Of the 60, 21% belonged to class 1, 11% belonged to Class 2 A, 13% belonged to class 2 B, 25 belonged to class 3, and 30% belonged to class 4. 45% belonged to mild disease (Fontaine Classes 1 and 2) and 55% belonged to severe disease (Fontaine Classes 3 and 4).

**Table 1: Mean platelet count, Hb, MCV, and ABPI**

Study variable	Mean
Platelet count	2.5367 ± 0.8632
Haemoglobin	11.2283 ± 2.28896
MCV	83.85 ± 9.064
ABPI	0.768 ± 0.1186

**Table 2: Comparison of age, Hb, MCV, ABPI, and platelet count between Fontaine classification**

Fontaine classification	Fontaine Class 1 and 2	Fontaine Class 3 and 4
Age	53.36 ± 16.751	58.13 ± 12.958
P-value	3.166	2.291
Hb	10.8 ± 2.05309	11.75 ± 2.4613
P-value	0.388	0.4351
MCV	84.32 ± 9.278	83.44 ± 9.002
P-value	1.753	1.591
ABPI	0.8 ± 0.1054	0.741 ± 0.1241
P-value	0.02	0.022
Platelet Count	2.4939 ± 0.88625	2.5741 ± 0.85494
P-value	0.16749	0.15113

**Table 3: Comparison of sex, CAD, and PAOD between Fontaine classification**

Fontaine class		Class 1&2	Class 3&4	P-value
Sex	Male	21 (48.8%)	22 (51.2%)	0.592
	Female	7 (41.2%)	10 (58.8%)	
CAD	Present	7 (35%)	13 (65%)	0.2
	Absent	21 (52.5%)	19 (47.5%)	
PAOD		8.5786 ± 0.72794	11.175 ± 0.90125	<0.001

**Table 4: Comparison of MPV with other variables**

		Mean SD	P-value
Sex	Male	9.9116 ± 1.53611	0.683
	Female	10.0941 ± 1.59392	
CAD	Yes	9.94 ± 1.56084	0.935
	No	9.975 ± 1.5513	
CVA	Yes	10.15 ± 1.32425	0.643
	No	9.9167 ± 1.60018	
Antiplatelet drugs	Yes	9.86 ± 1.54704	0.665

	No	10.0371 ± 1.55546	
Tobacco	1	9.8636 ± 1.57496	0.584
	2	10.0852 ± 1.51979	
Alcohol	1	9.7476 ± 1.40912	0.431
	2	10.0795 ± 1.61362	
Hypertension	Yes	9.14 ± 1.326	0.152
	No	12.637 ± 1.1971	

There were no significant differences in age, Hb, MCV, or platelet count between the Fontaine classifications. A significant difference was observed in the ABPI between the Fontaine classification systems [Table 2].

There was no significant difference in sex or CAD between the Fontaine classifications. A significant association was observed between the mean platelet volume and the severity of PAOD according to the Fontaine classification, with a p-value of <0.001 [Table 3].

There was no significant difference in sex, CAD, CVD, antiplatelet drugs, Tobacco, Alcohol, and Hypertension between the mean platelet volumes [Table 4].

## DISCUSSION

PAOD is a disease that causes significant morbidity and rarely causes mortality. PAOD depletes the standard of living and takes a huge toll into a patient's daily life activities. It is a crippling disease with a significant socioeconomic burden. The Mean Platelet Volume is a significant independent risk factor for vascular diseases involving coronary, cerebrovascular, and peripheral arterial atherosclerotic diseases. The larger the size of the platelets, the more enzymatically active they are and the more severe the degree of occlusive disease. Various studies have demonstrated the link between MPV and severity of CAD and CVA. In this study, we proved that the same significant relationship exists between the average size of all platelets, MPV, and severity of PAOD measured by the Fontaine classification.

This study comprised 60 patients with established diagnoses of PAOD under Doppler and ABPI measurements whose characteristics agreed with the inclusion and exclusion criteria. They were classified based on their symptoms using the Fontaine classification system, and various characteristics were compared. Most patients were men (71%), compared to women (29%). This was in contrast to the National Health and Nutrition Examination Survey 1999-2000, in which age-wise distributions were approximately equal. 21% of the study population fell into Fontaine Class 1, 11.7 were classified as class 2-A, and 13.3% were classified as class 2 B. Class 3 disease was observed in 25% of the study group, and 28% had class 4 symptoms. This reflects that these patients presented late to our institution, as most of the study population fell in the more severe PAOD class. This could also be a reporting bias, as our study was conducted in a

tertiary care centre. Regarding age distribution, no patients were below 30 years, whereas 39(65%) were in the age group between 30-59, and 20 patients (20%) were in the age group between 60-90. One patient was above 90 years of age.

A study by Allison MA et al. showed a near-linear relationship between advancing age and PAOD prevalence. 25 out of the 60 patients suffered from systemic hypertension, whereas 20 had coronary artery disease, and 12 suffered at least one episode of CVA. 41% of the study group was on antiplatelet drugs, 33% had the habit of consuming alcohol, and 55% used tobacco in one form or the other. The mean MPV of all patients were 9.96fL, the maximum MPV was 12.1, and the lowest MPV was 7.6. On statistical assessment of various parameters in search of significant association, the study established a significant association between mean platelet volume and severity of PAOD using the Fontaine classification, with a significant p-value of <0.001.<sup>[12]</sup> Similar studies by Berger et al. also demonstrated results concurred with our observations. The severity of PAOD did not show any significant association with other parameters, such as between haemoglobin concentration (p=0.23), mean corpuscular volume (p=0.71), ankle brachial pressure index (p=0.52), platelet count (p=0.73) nor with age (p=0.20). There was no significant association between CAD, alcohol use, and tobacco use (p = 0.20, 0.08, and 0.775, respectively).<sup>[13]</sup>

Furthermore, we compared the association of mean platelet volume with various other characteristics and found no significant association between MPV and age (p=0.68). There was no significant correlation between MPV and systemic hypertension (p=0.152) or the incidence of CAD (p=0.93). Similarly, there was no significant correlation between MPV and the incidence of CVA (p=0.64). There was also no significant relationship between MPV and antiplatelet medications (p=0.66) or with substances such as alcohol (p=0.43) and tobacco use (p=0.58). Hence, the study proved the anticipated outcome: a significant association between MPV and severity of PAOD according to the Fontaine classification.

## CONCLUSION

The MPV indicates platelet function and predicts the severity of various vascular events, including CAD, CVD, and PAOD. Larger platelets contain more enzymatically active molecules owing to the increased number of granules rich in active substances, contributing to higher activity. Larger platelet counts in patients appear to correlate

positively and significantly with PAOD severity. Hence, patients with larger MPV should be given greater attention and treated aggressively to prevent morbidity and progression of the disease.

### Limitations

This study was conducted at a single centre, with a study population of 60. Larger multi-centric trials should be performed before generalisations can be made. Females accounted for only 28% of the entire study group, which could be due to reporting bias and could have affected the results. Further prospective studies are required to ascertain the progression of PAOD in these patients to determine the effect of MPV on disease progression.

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