

Dysfunction of the arteriovenous fistula and Mean Platelet Volume (MPV): What relationship?

ABSTRACT:

Dysfunctions of the AVF such as thrombosis or stenosis are frequent complications. One of the main factors at the origin of these dysfunctions is an anomaly of coagulation dependent on overactive platelets during chronic renal insufficiency. Younger, more excitable platelets are larger in size. Mean platelet volume (MPV) is a risk marker for major cardiovascular events. This is a retrospective analytical study including chronic hemodialysis patients for more than 6 months on AVF at the CHU Ibn Rochd hospital in Casablanca over a period of 5 years, from January 2018 to January 2023. The population was divided into 4 levels of MPV determined according to the quartiles of MPV in our cohort, group 1: $MPV \leq 10\text{fl}$, group 2: $10.1\text{fl} \leq MPV < 10.7\text{fl}$, group 3: $10.7\text{fl} \leq MPV < 11.5\text{fl}$, group 4: $MPV \geq 11.5\text{fl}$. The four groups were compared with regard to the occurrence of AVF dysfunctions. Forty-four hemodialysis patients on AVF were collected, 20 men (45.5%) and 24 women (54.5%). a sex ratio F/M of 1.2. The average age of the patients was 45.25 ± 13.78 years [18 – 69] the average seniority in hemodialysis was 14.23 ± 8.807 years [2 – 34] AVF complications were noted in 38.6% of cases (n=17), including 27.2% thrombosis (n=12), 4.5% stenosis (n=2) and 2.27% had bleeding (n=1). The MPV was $10.61 \text{ fl} \pm 1.305$ [8–14]. We noted a statistically significant difference in the occurrence of vascular access events according to the MPV quartile ($p = 0.005$). Seven events (41.1%) were noted in group 4 (upper quartile), 6 (35.2%) in group 3, 3 (17.64%) in group 2 and 1 (5.88%) in group 1. We also found a statistically significant correlation for the recurrence of thrombosis according to the MPV quartile ($p = 0.003$). Indeed, in the 4th group, 1 patient had relapsed 6 times, 1 patient had thrombosed his AVF 4 times, 2 patients had thrombosed their AVF 3 times and 2 others had relapsed twice. A high MPV helps identify patients at risk for AVF events. This at-risk population could thus benefit from reinforced and close monitoring, or even antiaggregation or anticoagulant therapy.

Keywords : arteriovenous fistula - hemodialysis - mean platelet volume - thrombosis.

INTRODUCTION :

Arteriovenous fistula (AVF) complications in the form of thrombosis or stenosis are common incidents in patients with chronic kidney disease (CKD).

Patients with CKD often present with vascular abnormalities such as intimal hyperplasia, endothelial dysfunction and a pro-coagulable tendency, which promote AVF thrombosis. One of the main factors responsible for these dysfunctions is the coagulation abnormality, which is dependent on overactive platelets during CRF.

Mean platelet volume (MPV) is a risk marker for major cardiovascular events [1-2]. An increase in MPV reflects increased platelet activity, indicating the presence of younger platelets that are more responsive to stimuli [3]. However, the VPM is inversely correlated to the total number of platelets, so as to maintain constant platelet mass in the body.

WORK OBJECTIVE:

The objective of this work is to look retrospectively for the relationship between mean platelet volume and the onset of AVF dysfunctions in hemodialysis patients.

MATERIAL AND METHODS

This is a descriptive and analytical retrospective study including 44 chronic hemodialysis patients for more than 6 months on AVF at the CHU Ibn Rochd hospital in Casablanca over a period of 5 years, from January 2018 to January 2023.

The population was divided into 4 VPM levels determined according to VPM quartiles, group 1: $VPM < 10\text{fl}$, group 2: $10\text{fl} \leq VPM < 10.7\text{fl}$, group 3: $10.7\text{fl} \leq VPM < 11.5\text{fl}$, group 4: $MPV \geq 11.5\text{fl}$. The four groups were compared with regard to the occurrence of AVF dysfunctions. AVF dysfunction was defined as the occurrence of the first episode of either thrombosis or stenosis

Thrombosis was clinically diagnosed by a complete absence of thrill. And stenosis was defined by a reduction of more than 50% of the lumen of the vessel on Doppler ultrasound and the need to perform angioplasty.

RESULTS :

- Epidemiological data:

We collected data from 44 hemodialysis patients on arteriovenous fistula. Among these patients, there were 20 men (45.5%) and 24 women (54.5%), giving an F/M sex ratio of 1.2. The mean age of the patients was 45.25 ± 13.78 years. The average seniority in hemodialysis was 168.36 months ± 105.9 . In addition, 95.6% of patients received three four-hour dialysis sessions per week.

- AVF Complications:

In our study, complications occurred in 38.6% (n=15) of patients with an arteriovenous fistula. Of these complications, 27.2% (n=12) were thromboses, 4.5% (n=2) were stenoses and 6.9% other

- Average VPM:

The mean VPM was 10.61 fl ± 1.305

The average of the average platelet volumes of the different groups is presented in Figure 1

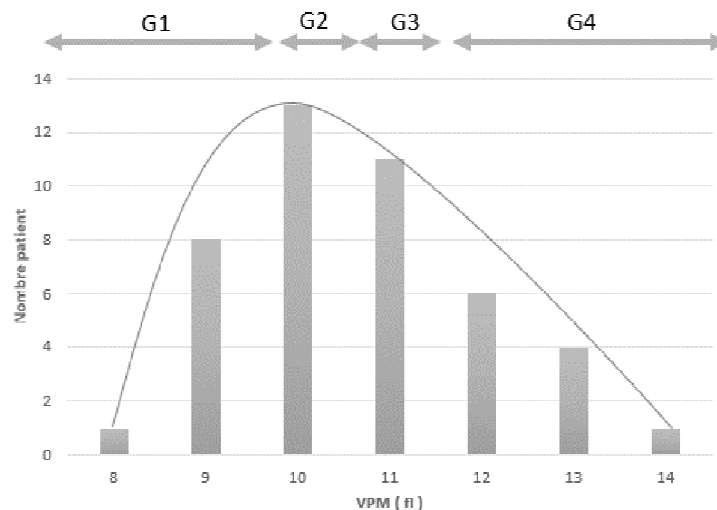


Figure 1: Average VPM according to the 4 groups

- Association between VPM and prevalence of AVF dysfunction:

In group 4 where the quartile is higher, seven events (50%) were observed, while in group 3, five events (35.7%) were noted. In group 2, one event (7.1%) was recorded, as in group 1.

Statistical analysis revealed a significant association between the occurrence of vascular thrombosis and the upper quartile of VPM, where a higher value of VPM was associated with an increase in vascular dysfunctions, in particular thromboses ($p = 0.005$). On the other hand, no significant correlation was found between the occurrence of stenosis and the dysfunction of the arteriovenous fistula. (Table 1)

Table 1: Prevalence of AVF dysfunctions in the 4 groups

	G1	G2	G3	G4	P
Thrombosis (%)	8.33%	8.33%	33.33%	50%	0.005
Strictures (%)	0%	0%	50%	50%	0.185

Kaplan-Meier analysis showed a statistically significant difference in the occurrence of any type of vascular access event as a function of MPV quartile ($p=0.004$) (Figure 2)

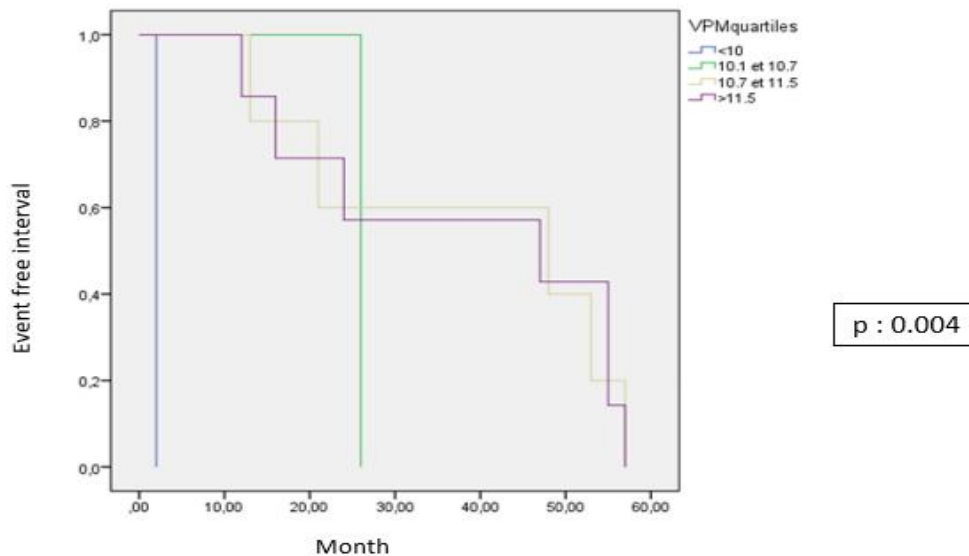


Figure 2: Kaplan–Meier diagram of vascular access events

- Association VPM and number of episodes of thrombosis:

A high prevalence of recurrence was found in the fourth group, compared to the other groups up to 6 episodes. Indeed, in the 4th group, 1 patient had relapsed 6 times, 1 patient had thrombosed his AVF 4 times, 2 patients had thrombosed their AVF 3 times and 2 others had relapsed twice.

We also observed a significant correlation between the recurrence of thrombosis and the upper quartile of the VPM ($p=0.003$)

DISCUSSION :

The key event in AVF failure is intimal hyperplasia. Platelets are implicated in intimal hyperplasia, such as shear stress, hypoxic injury, inflammation, uremia and thrombosis [4].

Large platelets with high MPV, containing denser α granules, aggregate faster after stimulation with ADP or collagen and secrete PDGF, TGF- β [5] PDGF is a growth factor involved in the development of intimal hyperplasia [6] and stimulates the mobilization, migration and proliferation of smooth muscle cells and inflammatory cells. TGF- β is a pro-inflammatory cytokine involved in the development of atherosclerotic plaques. PDGF [4] and TGF- β [7] are described in large quantities in the intima of VA stenoses.

Moreover, platelets are important in the initiation of thrombosis and activated platelets could increase the thrombotic risk. Greater platelet aggregability has been reported in patients with VA dysfunction [8]. Stenosis promotes AV thrombosis.

In a French study, the risk of having an AVF event is three times higher in patients with the highest VPM values than in those with the lowest VPM values [9], which is consistent with the results of our study, with a strong association between the increase in MPV and the occurrence of AVF dysfunction as well as its recurrence.

A recent study conducted on a nationwide retrospective cohort of 149,000 patients showed that increased MPV was associated with increased mortality, but not cardiovascular events [10] identifying a group of patients with the highest MPV (≥ 11.5 fl), researchers observed that these patients were more likely to experience vascular events. Our results are consistent with two recent studies [11,12] and prove that this population could benefit from closer monitoring to prevent thrombosis. A

larger study is needed to assess the effectiveness of this strategy on longevity and vascular access failure. This study does not make it possible to conclude on the role of activated platelets in the failure of vascular access. A high MPV could be a marker of dysfunctional VA. One possible hypothesis is that VA stenosis stimulates hemostasis, leading to increased platelet consumption and increased platelet turnover, leading to the production of larger platelets. Future studies could look at the evolution of VPM after failure of vascular access.

CONCLUSION :

Our study clearly established that the risk of events occurring on an arteriovenous fistula (AVF) was related to a high VPM. Therefore, VPM can be used to identify patients at increased risk of events on their AVF. These patients at risk could benefit from closer monitoring, or even antiplatelet or anticoagulant treatments. Limiting the number of events on the AVF could help prevent thrombosis and loss of vascular access, which expose patients to life-threatening risk.

Ethical Approval:

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

Consent

As per international standard or university standard, patient(s) written consent has been collected and preserved by the author(s).

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