Asian Journal of Research in Nephrology

Volume 6, Issue 1, Page 60-64, 2023; Article no.AJRN.99647

Dysfunction of the Arteriovenous Fistula and Mean Platelet Volume (MPV): What Relationship?

S. Hamine [a*], Z. Benamara [a], F. Sounni [a], M. Zamd [a], N. Mtioui [a], S. S. El Khayat [a], G. Medkouri [a] and M. Benghanem [a]

[a] *Department of Nephrology, Hemodialysis and Renal Transplantation, University Hospital Center Ibn Rochd, Casablanca, Morocco.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/99647

Original Research Article

Received: 08/03/2023
Accepted: 11/05/2023
Published: 19/05/2023

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 ≤ 10fl, group 2: 10.1fl ≤ MPV < 10.7fl, group 3: 10.7fl≤ MPV < 11.5fl, group 4: MPV ≥ 11.5fl. 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

**Corresponding author: E-mail: Salmahamine@gmail.com;*

± 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 fl ± 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.

1. 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 MPV is inversely correlated to the total number of platelets, so as to maintain constant platelet mass in the body.

1.1 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.

2. MATERIALS 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 MPV levels determined according to MPV quartiles, group 1:

MPV < 10fl, group 2: 10fl ≤ MPV < 10.7fl, group 3: 10.7fl ≤ MPV < 11.5fl, group 4: MPV ≥ 11.5fl. 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.

3. RESULTS

3.1 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.

3.2 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

3.3 Average MPV

The mean MPV was 10.61 fl ± 1.305.

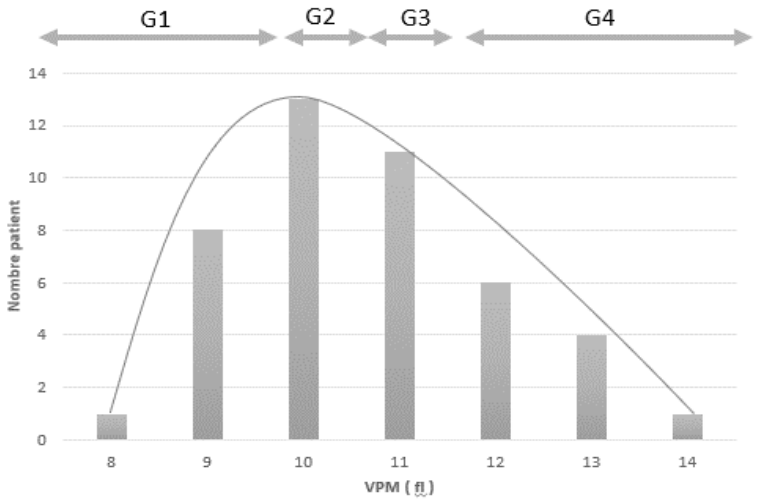

Fig. 1. Average MPV according to the 4 groups

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

3.4 Association between MPV 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 MPV, where a higher value of MPV 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).

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) (Fig. 2).

3.5 Association MPV 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 MPV (p=0.003).

4. 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.

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

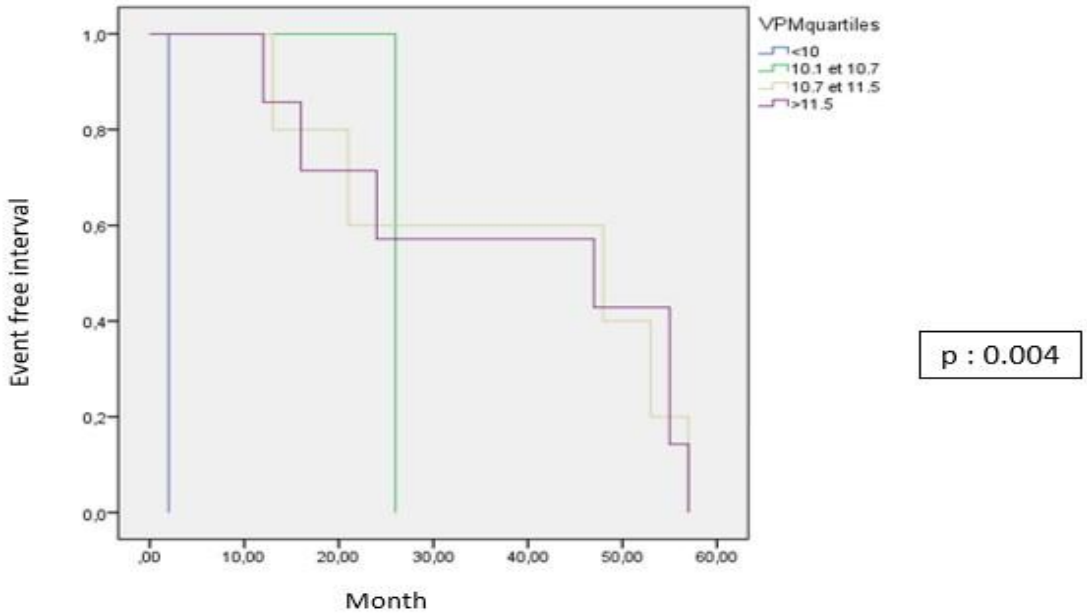

Fig. 2. Kaplan–Meier diagram of vascular access events

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 MPV values than in those with the lowest MPV 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 MPV after failure of vascular access.

5. CONCLUSION

Our study clearly established that the risk of events occurring on an arteriovenous fistula (AVF) was related to a high MPV. Therefore, MPV 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.

CONSENT

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

ETHICAL APPROVAL

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

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Chu SG, Becker RC, Berger PB, Bhatt DL, Eikelboom JW, Konkle B, et al. Mean platelet volume as a predictor of cardiovascular risk: A systematic review and meta-analysis. J Thromb Haemost. 2010;8(1):148-56.
2. Noris P, Melazzini F, Balduini CL. New roles for mean platelet volume measurement in the clinical practice? Platelets. 2016;27(7):607-12.
3. Leader A, Pereg D, Lishner M. Are platelet volume indices of clinical use? A multidisciplinary review. Ann Med. 2012;44(8):805-16.
4. Roy-Chaudhury P, Sukhatme VP, Cheung AK. Hemodialysis vascular access dysfunction: A cellular and molecular viewpoint. J Am Soc Nephrol. 2006;17(4): 1112-27.
5. Badrnya S, Schrottmaier WC, Kral JB, Yaiw KC, Volf I, Schabbauer G, Söderberg-Nauclér C, Assinger A. Platelets mediate oxidized low-density lipoprotein-induced monocyte extravasation and foam cell formation. Arterioscler. Thromb. Vasc. Biol. 2014;34: 571–580.
6. Alvarez RH, Kantarjian HM, Cortes JE. Biology of platelet-derived growth factor and its involvement indisease. Mayo Clin Proc. 2006;81(9):1241-57.
7. Stracke S, Konner K, Köstlin I, Friedl R, Jehle PM, Hombach V et al. Increased expression of TGF-beta1 and IGF-I in inflammatory stenotic lesions of hemodialysis fistulas. Kidney Int. 2002; 61(3):1011-9.
8. ElChoufani SE, Bolin P, Waien S, Christiano CR, Holbert D, Bode AP. Platelet adhesion testing may predict early hemodialysis arteriovenous graft and fistula failure in end-stage renal disease patients. Clin Appl Thromb Hemost. 2008;14(4):399-409.
9. Lano G, Sallée M, Pelletier MP, Bataille S, Fraisse M, Berda-Haddad Y et al. Mean platelet volume predicts vascular access events in hemodialysis patients. J Clin Med. 2019;8(5):2077-0383.
10. Kim S, Molnar MZ, Fonarow GC, Streja E, Wang J, Gillen DL, et al. Mean platelet volume and mortality risk in a national incident hemodialysis cohort. Int J Cardiol. 2016;220:862-70.
11. Cho A, Choi MJ, Lee YK, Hoon HC, Koo JR, Yoon JW, Noh JW. Effects of aspirin resistance and mean platelet volume on vascular access failure in hemodialysis patients. Korean J Intern Med; 2018.
12. Shin DH, Rhee SY, Jeon HJ, Park JY. Kang, SW, Oh, J. An increase in mean platelet volume/platelet count ratio is associated with vascular access failure in hemodialysis patients. Plos One. 2017; 12:0170357.

Peer-review history:
The peer review history for this paper can be accessed here:
https://www.sdiarticle5.com/review-history/99647