Review Article

Could mean platelet volume be a useful marker for infectious diseases? a review of literature

Murat Afyon[1], Cumhur Artuk[2]

[1]GATA Haydarpasa Training Hospital, Primary Care and Examination, Family Health Center and the Naval Academy Clinic, Istanbul, Turkey.
[2]GATA Training and Research Hospital, Department of Infectious Diseases, Ankara, Turkey.

Abstract

Mean platelet volume (MPV), a parameter of complete blood count analysis, measures the average size of platelets. The alterations of MPV levels have been described as a diagnostic or prognostic predictor in patients with infectious diseases including sepsis, infective endocarditis, pneumonia, brucellosis, cellulitis, acute pyelonephritis, ascites fluid infection, hepatitis B or hepatitis C in recent studies. Although some matters still remain unclear, it can be said that MPV, especially in a scoring system, may be a cost-effective and useful marker for monitoring and predicting outcomes in patients with some infectious diseases in the future.

Keywords: Mean platelet volume, infectious diseases, sepsis, hepatitis, infective endocarditis, pneumonia, brucellosis

Aside from their function in haemostasis, platelets have also a crurical role in the inflammatory response, and also their counts may change in parallel with the severity of infections [1-11]. In addition to changes in platelet counts during infections, platelet sizes can be altered by some factors such as platelet formation from megakaryocytes in response to thrombocytopenia or the release of platelet granules due to the activation of platelets [1-4].

Mean platelet volume (MPV), a parameter of complete blood count analysis, measures the average size of the platelets and indicates platelet activation. Because of that they contain more intense granules, more thrombotic platelets are larger. Recently, the role of MPV in patients with cardiovasculer, rheumatic, inflammatory or infectious disorders has been evaluated in several studies. It has been reported that MPV levels can be affected by not only prothrombotic conditions including obesity, hypercholesterolemia, diabetes, hypertension, smoking and arterial stiffness but also proinflammatory conditions including rheumatic diseases or infectious disorders [1-16].

In consequence of the reduction of platelet counts, with stimulation of megakaryocytes by thrombopoietin, the production of larger platelets increases. So, an inverse relationship between platelet size and platelet count is expected [7]. However, whereas high MPV levels have been showed in destructive thrombocytopenia, there are low MPV levels in hypoproliferative thrombocytopenia [1]. Accordingly, it is considered that MPV levels may increase in mild inflammation because of the raise of large platelets, or on the contrary, MPV levels may decrease in severe inflammation owing to the depletion of large platelets in inflammatory area [13]. Thus, MPV may be a negative acute phase reactant as well as a positive acute phase reactant. Also, it has been indicated that MPV levels may show fluctuation in different phases of sepsis [1,2,4].

Furthermore, the alterations of MPV levels have been described as a diagnostic or prognostic predictor in patients with cardiovasculer disorders (e.g. myocardial infarction, ischemic stroke, mesenteric ischemia, deep vein trombosis, decompansated heart failure) or infectious diseases [e.g. sepsis, infective endocarditis, pneumonia, brucellosis, cellulitis, acute pyelonephritis (APN), ascites fluid infection (AFI), hepatitis B or hepatitis C] [1-16].

MPV and Sepsis: Lower platelet counts and higher MPV levels have been reported in septic patients than in controls [1-4]. And, it has been reported that MPV levels didn't increase in non-invasive local infection or sepsis with negative blood culture [2]. Also, it has been indicated that MPV levels were higher in patients with severe sepsis or in non-survivors [1, 2]. Among non-survivors with sepsis,

*Corresponding Author: Murat Afyon, GATA Haydarpasa Training Hospital, Primary Care and Examination, Family Health Center and the Naval Academy Clinic, Tuzla/Istanbul, Turkey.
E-mail: muratafyon2002@yahoo.com

there are different trends in MPV levels. In a study, all patients died in the first week of infection have been showed to have increasing MPV levels on death day [17]. In another one, among non-survivors, there were two phase of MPV levels. Firstly, there were no elevation or lower increase in non-survivors than survivors in first phase [4]. Then, MPV levels increased and remained higher than survivors in the second phase [4]. Thereby, MPV elevation at the begining of infection has been indicated to be a protective prognostic factor, whereas later elevation of MPV levels has been described as a negative prognostic factor [4]. Dissimilarly, MPV levels have been notified to be statistically higher in non-survivors with septic shock on admission in a different study [2]. MPV over 10.5 fl on admission or on the first three days has been defined as a good predictor of mortality [2]. Also, no significant changes has been reported in MPV levels between early and later onset sepsis in preterm infants [3]. An MPV value of 10.75 fl at diagnosis has been determined as the cut-off value for possibly resulting in death [3]. As another discrepancy, in different trials, the optimal cut-off values for sepsis diagnosis were 8 fl in adults and 11.4 fl in neonatals with similar sensivity (respectively; 87.41% vs. 88.4%) and specifity (respectively; 53.47% vs. 40.5%) rates [1,18]. Morever, while MPV has been reported to have more prognostic power than APACHE (acute physiology and chronic health evaluation) II score and procalcitonin but lower prognostic power than lactate in prediction sepsis outcomes in adult patients, the diagnostic accuracy of MPV has been found to be inferior to C-reactive protein (CRP) in neonatals [2,18].

MPV and Infective Endocarditis: In patients with infective endocarditis, higher MPV values than controls, MPV levels over 8.6 fl on admission as a strong independent indicator of embolic events and in-hospital mortality, increasing trends for MPV levels associated with adverse events and mortality, reduction in MPV levels by treatment have been demonstrated [5,19].

MPV and Viral Hepatitis: While there was no significant difference in MPV levels between acute hepatitis B patients and healthy controls, higher MPV values in chronic hepatitis B patients compared with acute hepatitis B patients or healthy controls have been indicated [8, 20]. Additionally, it has been reported that MPV can be defined as independent predicting factor in hepatic fibrosis [8]. And also, MPV levels have been showed to be positively correlated with the model for end-stage liver disease (MELD) score [20]. However, elevation in MPV levels have been reported to be an independent predictor for cirrhosis or fibrosis, on the contrary, low levels of MPV have been also described as independent variables determining the severity of fibrosis [8-10]. Also, in a recent study comparing MPV levels in patients with hepatitis B or hepatitis C, no reliable results in hepatitis B groups have been found [7]. Contrarily, in patients with

hepatitis C, MPV has been described as a useful marker in predicting advanced liver damage [7].

MPV and Pneumonia: MPV values have been reported to be found significantly lower in patients with pneumonia compared with controls [21]. In another study including patients with community-acquired pneumonia, MPV values have been reported to be significantly different between survivors [9.3±1.2 fl] and non-survivors [8.1±0.6 fl] [6]. Besides the levels of MPV, the authors indicated that CURB-65 (Confusion, Urea, Respiratory rate, Blood pressure, over 65 years of age) score was inversely correlated with MPV, and also, the prediction accuracy of 28-day mortality in patients with community-acquired pneumonia was enhanced by a combination of CURB-65 score and MPV [6].

MPV and Brucellosis: Association between MPV and brucellosis remains unclear. Compared with controls, lower MPV levels in patients with brucellosis, or higher MPV levels in children with brucella arthritis, or lastly similiar MPV levels in acute brucellosis patients have been showed [11,22-25]. There are also trials showing lower MPV values in Brucella patients with splenomegaly or indicating no significantly difference in MPV levels compared with patients without splenomegaly [11,23]. Furthermore, following the assessment of pretreatment and posttreatment MPV levels in patients with Brucellosis, MPV levels have been reported to increase with therapy [11,23].

Correlations between MPV and Brucella serum tube agglutination test (STAT), CRP or erythrocyte sedimantation rate (ESR) are also questionable. No difference in MPV values between patient groups according to their STAT results has been found [22]. Furthermore, there are studies indicating a negative correlation or no correlation between MPV-STAT, MPV-CRP or MPV-ESR in Brucella patients [11,22-26]. Except from Brucellosis patients, although MPV has been reported to be inversely correlated with CRP and ESR in a trial investigating children with diagnosis of infection or inflammatory diseases, MPV values have been found positively correlated with CRP in patients with cellulitis and in children with urinary tract infection [13,14,27].

MPV and Some Other Infectious Diseases: MPV levels were higher in children with APN than in those with lower urinary tract infection, but its predictive capacity compared with CRP in children with APN is debated [13, 15]. MPV levels have been found higher in cirrhotic patients with AFI than in those without bacterial infection or in healthy controls [16,28]. And also, MPV has been described as a diagnostic predictor for AFI and a novel and useful predictor of systemic inflammatory response syndrome in cirrhotic patients with AFI [16,28]. Whereas no significant relation between MPV and Dengue fever has been demonstrated, increased MPV values in malaria have been

defined as a useful predictive marker for severity of infection [12,29]. It has been also reported that MPV values were higher compared with controls and MPV values might be a prognostic factor in patients with cellulitis [14].

Conclusion

It is a fact that MPV is an easily accessible parameter from complete blood count analysis and MPV levels can be reduced, increased or affected such a bifasic pattern by infection. Although some matters including the course of MPV values, the cut-off values for MPV, or significance of lonely use of the MPV levels in patients with different infectious diseases still remain unclear, it can be said that MPV, especially in a scoring system, may be a cost-effective and useful marker for monitoring and predicting outcomes in patients with particularly invasive infectious diseases such as sepsis and infective endocarditis or for evaluating fibrosis degree in patients with viral hepatitis. However, in order to highlight the role and importance of MPV and cut-off values for MPV in patients with different infectious diseases, randomized large-scale studies are required.

References

1. Guclu E, Durmaz Y, Karabay O. Effect of severe sepsis on platelet count and their indices. Afr Health Sci. 2013;13(2):333-8.

2. Gao Y, Li Y, Yu X, Guo S, Ji X, Sun T, Lan C, Lavergne V, Ghannoum M, Li L. The impact of various platelet indices as prognostic markers of septic shock. PLoS One. 2014;9(8): e103761.

3. Catal F, Tayman C, Tonbul A, Akça H, Kara S, Tatli MM, Oztekin O, Bilici M. Mean platelet volume (MPV) may simply predict the severity of sepsis in preterm infants. Clin Lab. 2014;60(7):1193-200.

4. Kitazawa T, Yoshino Y, Tatsuno K, Ota Y, Yotsuyanagi H. Changes in the mean platelet volume levels after bloodstream infection have prognostic value. Intern Med. 2013;52(13):1487-93.

5. Tok D, Canpolat U, Tok D, Turak O, İşleyen A, Öksüz F, Mendi MA, Çağlı K, Başar FN, Gölbaşı Z. Association of mean platelet volume level with in-hospital major adverse events in infective endocarditis. Wien Klin Wochenschr. 2015;127(5-6):197-202.

6. Golcuk Y, Golcuk B, Bilge A, Irik M, Dikmen O. Combination of mean platelet volume and the CURB-65 score better predicts 28-day mortality in patients with community-acquired pneumonia. Am J Emerg Med. 2015;33(5):648-52.

7. Eminler AT, Uslan MI, Ayyildiz T, Irak K, Kiyici M, Gurel S, Dolar E, Gulten M, Nak SG. Mean platelet volume is an important predictor of hepatitis C but not hepatitis B liver damage. J Res Med Sci. 2015;20(9):865-70.

8. Karagoz E, Ulcay A, Tanoglu A, Kara M, Turhan V, Erdem H, Oncul O, Gorenek L. Clinical usefulness of mean platelet volume and red blood cell distribution width to platelet ratio for predicting the severity of hepatic fibrosis in chronic hepatitis B virus patients. Eur J Gastroenterol Hepatol. 2014;26(12):1320-4.

9. Qi XT, Wan F, Lou Y, Ye B, Wu D. The mean platelet volume is a potential biomarker for cirrhosis in chronic hepatitis B virus infected patients. Hepatogastroenterology. 2014;61(130):456-9.

10. Ceylan B, Mete B, Fincanci M, Aslan T, Akkoyunlu Y, Ozguneş N, Colak O, Gunduz A, Senates E, Ozaras R, Inci A, Tabak F. A new model using platelet indices to predict liver fibrosis in patients with chronic hepatitis B infection. Wien Klin Wochenschr. 2013;125(15-16):453-60.

11. Kader C, Yolcu S, Erbay A. Evaluation of mean platelet volume (MPV) levels in brucellosis patients. Cumhuriyet Medical Journal. 2013;35(4):488-94.

12. Leal-Santos FA, Silva SB, Crepaldi NP, Nery AF, Martin TO, Alves-Junior ER, Fontes CJ. Altered platelet indices as potential markers of severe and complicated malaria caused by Plasmodium vivax: a cross-sectional descriptive study. Malar J. 2013;12:462.

13. Lee IR, Shin JI, Park SJ, Oh JY, Kim JH. Mean platelet volume in young children with urinary tract infection. Sci Rep. 2015;5:18072.

14. Erturk A, Cure E, Cure MC, Parlak E, Kurt A, Ogullar S. The association between serum YKL-40 levels, mean platelet volume, and c-reactive protein in patients with cellulitis. Indian J Med Microbiol. 2015;33:61-6.

15. Tekin M, Konca C, Gulyuz A, Uckardes F, Turgut M. Is the mean platelet volume a predictive marker for the diagnosis of acute pyelonephritis in children? Clin Exp Nephrol. 2015;19(4):688-93.

16. Abdel-Razik A, Eldars W, Rizk E. Platelet indices and inflammatory markers as diagnostic predictors for ascitic fluid infection. Eur J Gastroenterol Hepatol. 2014;26(12):1342-7.

17. Van der Lelie J, Von dem Borne AK. Increased mean platelet volume in septicaemia. J Clin Pathol. 1983;36(6):693-6.

18. Yao Y, Tu Y, Lu Q. Values of C-reactive protein, percentage of neutrophils and mean platelet volume in early diagnosis of neonatal sepsis. Zhongguo Dang Dai Er Ke Za Zhi. 2015;17(5):425-9.

19. Cho SY, Jeon YL, Kim W, Kim WS, Lee HJ, Lee WI, Park TS. Mean platelet volume and mean platelet volume/platelet count ratio in infective endocarditis. Platelets. 2014;25(8):559-1.

20. Hu Y, Lou Y, Chen Y, Mao W. Evaluation of mean platelet volume in patients with hepatitis B virus infection. Int J Clin Exp Med. 2014;7(11):4207-13.

21. Eser I, Sak ZHA, Günay Ş, Yalçın F, Kürkçüoğlu IC. Mean platelet volume as a diagnostic indicator in pneumonia disease. Tıp Araştırmaları Dergisi. 2014:12(1):12-4.

22. Okan DH, Gökmen Z, Seyit B, Yuksel K, Cevdet Z, Deniz A. Mean platelet volume in brucellosis: correlation between brucella standard serum agglutination test results, platelet count, and C-reactive protein. Afr Health Sci. 2014;14(4):797-801.

23. Bozkurt F, Aslan E, Deveci O, Tekin R. Evaluation of mean platelet volume levels in patients with brucellosis. Anatol J Clin Investig. 2014;8(3):126-9.

24. Aktar F, Tekin R, Bektaş MS, Güneş A, Köşker M, Ertuğrul S, Yılmaz K, Karaman K, Balık H, Yolbaş İ. Diagnostic role of inflammatory markers in pediatric Brucella arthritis. Ital J Pediatr. 2016;42(1):3.

25. Togan T, Narci H, Turan H, Ciftci O, Kursun E, Arslan H. The impact of acute brucellosis on mean platelet volume and red blood cell distribution. Jundishapur J Microbiol. 2015;8(2):e20039.

26. Öztürk ZA, Sayıner H, Kuyumcu ME, Yesil Y, Savas E, Sayıner ZA, Kısacık B, Kepekçi Y. Mean platelet volume in assessment of brucellosis disease. Biomed Res-India. 2012;3(4):541-6.

27. Zareifar S, Farahmand Far MR, Golfeshan F, Cohan N. Changes in platelet count and mean platelet volume during infectious and inflammatory disease and their correlation with ESR and CRP. J Clin Lab Anal. 2014;28(3):245-8.

28. Gálvez-Martínez M, Servín-Caamaño AI, Pérez-Torres E, Salas-Gordillo F, Rivera-Gutiérrez X, Higuera-de la Tijera F. Mean platelet volume as a novel predictor of systemic inflammatory response in cirrhotic patients with culture-negative neutrocytic ascites. World J Hepatol. 2015;7(7):1001-6.

29. Sharma K, Yadav A. Association of Mean Platelet Volume with Severity, Serology & Treatment Outcome in Dengue Fever: Prognostic Utility. J Clin Diagn Res. 2015;9(11):EC01-3.