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Original Article

Which has an Influence on Mean Platelet Volume: Allergic Rhinitis or Asthma?

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ABSTRACT

Aim: Bronchial asthma and allergic rhinitis are mediated by similar allergic inflammatory mechanisms. Platelets play a role in allergic reactions which are inflammatory processes. The mean platelet volume (MPV) is a marker of platelet activation. This study aimed to investigate MPV value differences between children with allergic rhinitis during symptomatic or asymptomatic periods to determine whether MPV is a useful indicator of inflammation in allergic rhinitis.

Materials and Methods: The records of those patients with allergic rhinitis were analyzed retrospectively. Patients over two years of age who had complete blood count results from both their asymptomatic and the symptomatic periods were included in this study. Clinical characteristics (age, age at diagnosis, symptoms, and comorbid allergic diseases) and laboratory data (thrombocyte count, MPV, white blood cell count, eosinophil count, and percentage, immunoglobulin E level, and skin prick test results) were recorded from the patient files and the hospital registry system.

Results: MPV values during the symptomatic periods were statistically significantly higher than those from the asymptomatic period ($p<0.001$) in all patients. When the patients were grouped according to having asthma or not, MPV was found to be higher in the symptomatic period compared to the asymptomatic period in the group with asthma, but there was no difference between these two periods in the group without asthma ($p=0.017$, $p=0.102$ respectively). Additionally, MPV levels were significantly higher in the asthma group during both the symptomatic and the asymptomatic periods ($p=0.04$, $p=0.013$, respectively).

Conclusion: This study suggests that MPV cannot be used as an inflammation indicator in the symptomatic period for patients with allergic rhinitis. Asthma influences MPV values. It is recommended to conduct more detailed and prospective studies to show MPV inflammation in AR.

Keywords: Allergic rhinitis, asthma, children, mean platelet volume

Introduction

Allergic rhinitis is an immunoglobulin E (IgE) based inflammation in the nasopharynx which occurs in reaction to an allergen. In 1998, the Joint Task Force on Practice Parameters in Allergy, Asthma, and Immunology defined allergic rhinitis as an "inflammation of the membranes lining the nose and is characterized by nasal congestion, rhinorrhea, sneezing, itching of the nose, and/or postnasal drainage" (1). Within minutes of allergen exposure, preformed and newly synthesized mediators, including

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histamine, cysteinyl leukotrienes, prostaglandins, and platelet-activating factor, are released by mast cells (2).

Asthma is one of the most commonly seen diseases, affecting >300 million people worldwide. It is also common during childhood. Asthma and allergic rhinitis share similar allergic inflammatory mechanisms. Grossman (3) suggested that asthma and allergic rhinitis are "one airway, one disease". It has been shown that untreated rhinitis can increase the risk of asthma exacerbation by up to three times (4).

Platelets have been shown to play a role in various inflammatory diseases, including atherosclerosis, atherothrombosis, and asthma. Platelet activation markers such as Plasma β-thromboglobulin and platelet factor-4 have been reported to be elevated in symptomatic asthmatic patients (5). These mediators activate eosinophils, increase the expression of Fc-IgG and Fc-IgE receptors, and release histamine from the basophils (6).

Platelet volume increases as platelets are activated. Mean platelet volume (MPV) reflects the platelet size and can be used as an indicator of activated platelets. Changes in MPV values have been studied, especially in asthma cases (7,8). There are conflicting results about MPV values in allergic rhinitis, and to the best of our knowledge, there are limited studies on MPV in allergic rhinitis in children.

This study aimed to investigate MPV value differences between children with allergic rhinitis during their symptomatic and asymptomatic periods to determine whether MPV is a useful indicator of inflammation in allergic rhinitis. In addition, we planned to assess the effects of atopy, concomitant allergic diseases, and other factors on MPV values.

Materials and Methods

This study was performed at the Pediatric Allergy Departments of three hospitals. It was approved by the University of Health Sciences Turkey, İzmir Tepecik Health Practice and Research Center Non-Interventional Research Ethics Committee (date: 28.03.2019, no: 2019/5-2). The records of those patients with allergic rhinitis from January 2015 to September 2018 were analyzed retrospectively. Those patients who were over two years old at the time of admission, followed up for at least six months and who had complete blood count results from both their asymptomatic and their symptomatic periods were included in this study. The diagnosis and classification of allergic rhinitis were made according to the Allergic Rhinitis and its Impact on Asthma guidelines, 2016 (4). Clinical characteristics (age, age at diagnosis, symptoms, comorbid allergic diseases especially asthma) and laboratory data (thrombocyte count, MPV, white blood cell count, eosinophil count, and percentage, IgE level, and skin prick test results) were recorded from the patient files and the hospital registry system. The reference range for MPV was between 7.0 and 11 fL. In addition, the patients were classified into 2 groups; without asthma and asthma with allergic rhinitis. The diagnosis of asthma was made according to the Global Initiative for Asthma, 2018 guidelines criteria (9).

Skin prick testing was performed using a panel of common inhalant allergens (grass, weed and tree pollens, cat and dog dander, molds, Dermathophagoides pteronyssinus, and Dermathophagoides farinae) (Allergopharma, Reinbek, Germany). Saline and histamine solutions were used as the negative and positive controls, respectively. The results were evaluated after 20 minutes. A wheal with a diameter of 3 mm greater than the negative control was taken as a positive result.

Patients who did not meet the allergic rhinitis diagnostic criteria or who had missing laboratory data were excluded from this study.

Statistical Analysis

Data were evaluated using the Statistical Package for Social Sciences 21.0 (SPSS for Windows 21.0, Inc., Chicago, IL, USA). The results were expressed as frequency (percentage) for categorical data and mean ± standard deviation for numerical data with normal distribution or median (minimum-maximum and interquartile range) for numerical data without normal distribution. The independent samples t-test was used to compare the groups; the Wilcoxon test was used to compare any changes between groups. Spearman correlation analysis was used while investigating the association between variables. Any p-values <0.05 were considered statistically significant.

Results

A total number of 250 patients who met the inclusion criteria were included in this study. There were 141 males (56.4%), the mean age of the patients was 8.7±3.9 years and the mean duration of the symptoms was 3.0±2.2 years. One hundred thirty-six of the patients had (54.4%) perennial symptoms. Among the patients, 148 (59.2%) had asthma, 6 (2.4%) had a food allergy, 5 (2%) had urticaria, and 1 (0.4%) had atopic dermatitis. The patients' clinical and demographic data are shown in Table I.

In the comparison of the laboratory test results during the symptomatic and asymptomatic periods, MPV values during the symptomatic period were statistically significantly higher than those from the asymptomatic period (p<0.001). Serum IgE levels and eosinophil counts were also higher in the symptomatic group (p<0001) (Table II).

To investigate those factors affecting MPV, patients were grouped according to the presence of asthma and skin test positivity. MPV was found to be higher in the symptomatic period compared to the asymptomatic period in the group with asthma, but there was no difference between these two periods in the group without asthma (p=0.017, p=0.102 respectively).

Additionally, when we compared MPV levels between the group with asthma and without asthma, MPV levels were significantly higher in the asthma group during the symptomatic and the asymptomatic periods (p=0.04, p=0.013, respectively).

In the skin prick test positive group, MPV levels were higher during the symptomatic period than the asymptomatic period (p=0.005). However, in the skin prick test negative group, there were no significant differences between MPV levels during the symptomatic period and the asymptomatic period (p<0.05) (Table III).

In addition, it was observed that a weak negative correlation was found between MPV and the presence of asthma both in the symptomatic period (p=0.04, r=-0.13) and the asymptomatic period (p=0.013, r=-0.16), but there was no correlation between skin test positivity, IgE level, eosinophil number and percentage, and platelet counts (p>0.05) (data are not shown).

Table I. Demographic and clinical characteristics of the patients

Gender (M/F)	141/109
Age: (years) [median (min.-max.)]	8.0 (3-20)
Disease duration: (years) (median: min.-max.)	2.0 (1-15)
Prick test positivity: n (%)	222 (88)
Comorbid allergic disease: n (%)	
Asthma	148 (59.2)
Food allergy	6 (2.4)
Urticaria	5 (2.0)
Atopic dermatitis	1 (0.4)
No other	90 (36)

M/F: Male/female, min.-max.: Minimum-maximum

Table II. The comparison of the laboratory parameters of the patients during their symptomatic and asymptomatic periods

Laboratory parameters	During symptomatic period	During asymptomatic period	p-value
IgE (IU/mL)*	284 (29.7-388.5)	249 (23.3-330)	<0.001
Platelet count (x10^3)/mm^3*	325 (247-346)	313 (252-358)	0.397
MPV (fL)**	8.0 (7.2-8.8)	7.7 (7.0-8.6)	<0.001
Eosinophil count/mm^3*	389 (100-500)	255 (100-300)	<0.001
Eosinophil (%)*	4.7 (2.0-7.0)	2.7 (1.0-4.0)	<0.001

*Median (IQR)
**Mean ± SD
SD: Standard deviation, IQR: Interquartile range

Table III. The investigation of the factors affecting MPV levels

The factors	MPV levels during the symptomatic period (mean ± SD)	MPV levels during the asymptomatic period (mean ± SD)	p-value
The presence of asthma			
Yes	7.6±1.1	7.8 ±1.3	0.017
No	8.0±1.3	8.2±1.2	0.102
The skin prick test results			
Positive	7.7±1.2	7.9±1.3	0.005
Negative	7.9 ±0.8	8.0±0.8	0.439

MPV: Mean platelet volume, SD: Standard deviation

Discussion

In this study, we found that MPV values were higher during the symptomatic period than during the asymptomatic period in those patients with allergic rhinitis and asthma, but this was not seen in those patients with only allergic rhinitis. In the literature, it has been shown that platelets show the capacity to become activated upon local and systemic allergic reactions. Atopic individuals have higher levels of chemokines, β-thromboglobulin, and platelet factor 4 than healthy subjects after allergen exposure, which is evidence of an increase in thrombopoiesis and the role of platelets in airway inflammation (10). Animal models have shown that platelet activation plays an important role in the transmigration of circulating lymphocytes and eosinophils to the airways of allergic asthma (11). The high degree of platelet activation causes an increase in platelet volume. MPV reflects the platelet size. Therefore, higher MPV levels predict platelet activity and thus the intensity of the inflammation.

Kowal et al. (12) investigated platelet activation after exposure to house dust mites in asthmatic patients. They reported that prolonged airway inflammation after allergen exposure of asthmatic patients was related to intravascular platelet activation. Knauer et al. (13) showed significant changes in PF-4 levels in the circulation and the bronchoalveolar lavage of asthmatic patients after bronchial provocation via ragweed extract with a decline in FEV1. On the other hand, studies indicate no difference or lower values of MPV between asthmatic patients and healthy controls (7,14).

Allergic rhinitis is the most common atopic disease strongly associated with asthma. From the pathophysiological point of view, both bronchial asthma and allergic rhinitis are mediated by similar allergic inflammatory mechanisms. In the literature, there are studies indicating no changes in platelet activation in allergic rhinitis patients. Kasperska-Zajac and Rogela (15) investigated circulating platelet activity in patients with house dust mite sensitive allergic rhinitis who had either mild asthma or no asthma, and they found no difference in the platelet count or PF-4 and Beta-transforming growth factor levels from control patients. They also showed no increase in the plasma levels of chemokines in grass pollen allergic patients with just intermittent rhinitis during the grass pollen season (16).

Akgedik and Yağız (17) compared the MPV values of 250 adult patients. They divided these patients into three groups as only allergic rhinitis, only asthmatics, and having both asthma and allergic rhinitis. They found the lowest MPV values in those patients in the allergic rhinitis and asthma group. In contrast, we found higher MPV levels in the allergic rhinitis and asthma group during the symptomatic period. This difference may be due to our patients' asthma not being under control, and this inflammation may have affected their MPV levels.

Kasperska-Zajac et al. (18) also evaluated platelet activity measured by plasma PF-4 levels during the non-pollen season compared with the pollen season for patients with asthma-allergic rhinitis and a control group. They found plasma PF-4 levels in the patients' non-pollen season were significantly lower than their pollen season levels and did not differ significantly compared to the healthy subjects. They suggested that this might indicate that platelet activation within the systemic circulation is an important factor in developing seasonal allergic airway inflammation.

Chen et al. (19) observed that plasma PF-4 and beta-thromboglobulin protein levels decreased after one year's sublingual immunotherapy with house dust mite in allergic rhinitis children. In addition, this decrease is positively related to symptom scores. As immunotherapy modifies the allergic process, the inflammation reduces, and MPV levels decrease.

Study Limitations

The most important limitation of our study is its retrospective design. Also, we did not evaluate any control parameters of asthma during the symptomatic period of rhinitis. It is possible that their asthma was not under control, and this may have affected their MPV values. Since we did not have a control group, we cannot comment on the importance of MPV in those patients with allergic rhinitis. On the other hand, our study is important as few other studies have evaluated MPV levels in pediatric allergic rhinitis patients to date. It would be good to conduct more detailed (more patients, using an asthma control test) and prospectively designed studies to show MPV inflammation in AR.

Conclusion

It was observed that MPV levels did not differ between the symptomatic and asymptomatic periods in those patients with only AR but they were higher in those patients with both asthma and allergic rhinitis during the symptomatic period. Therefore, it was thought that MPV could not be used as an inflammation indicator in the symptomatic period for patients with allergic rhinitis alone.

Ethics

Ethics Committee Approval: This study was approved by the University of Health Sciences Turkey, İzmir Tepecik Health Practice and Research Center Non-Interventional Research Ethics Committee (date: 28.03.2019, no: 2019/5-2).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: H.D.Ş., E.E.Ö., Ö.S., M.D., T.T., Concept: H.D.Ş., Ö.S., T.T., Design: H.D.Ş., E.E.Ö., Ö.S., M.D., T.T., Data Collection and/or Processing: H.D.Ş., E.E.Ö., Ö.S., M.D., T.T., Analysis and/or Interpretation: H.D.Ş., T.T., Literature Search: H.D.Ş., T.T., Writing: H.D.Ş., T.T.

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References

1. Dykewicz M, Fineman S, Skoner DP, et al. Diagnosis and management of rhinitis: complete guidelines of the joint task force on practice parameters in allergy, asthma, and immunology. Ann Allergy Asthma Immunol 1998; 81:478-518.
2. Naclerio R. Allergic rhinitis. N Engl J Med 1991; 325:860-8.
3. Grossman J. One airway, one disease. Chest 1997 Feb;111(2 Suppl):11S-16S.
4. Brożek JL, Bousquet J, Agache I, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines-2016 revision. J Allergy Clin Immunol 2017; 140:950-8.
5. Johansson MW, Han ST, Gunderson KA, Busse WW, Jarjour NN, Mosher DF. Platelet activation, P-selectin, and eosinophil β1-integrin activation in asthma. Am J Respir Crit Care Med 2012; 185:498-507.
6. Page C, Pitchford S. Platelets and allergic inflammation. Clin Exp Allergy 2014; 44:901-13.
7. Tuncel T, Uysal P, Hocaoglu AB, Erge DO, Karaman O, Uzuner N. Change of mean platelet volume values in asthmatic children as an inflammatory marker. Allergol Immunopathol (Madr) 2012; 40:104-7.
8. Kasperska-Zajac A, Nowakowski M, Rogala B. Enhanced platelet activation in patients with atopic eczema/dermatitis syndrome. Inflammation 2004; 28:299-302.
9. GINA report, Global Strategy for Asthma Management and Prevention2018. Updated August 2018. Available from http://www.ginasthma.org/
10. Pitchford SC, Riffo-Vasquez Y, Sousa A, et al. Platelets are necessary for airway wall remodeling in a murine model of chronic allergic inflammation. Blood 2004; 103:639-47.
11. Pitchford SC, Momi S, Giannini S, et al. Platelet P-selectin is required for pulmonary eosinophil and lymphocyte recruitment in a murine model of allergic inflammation. Blood 2005; 105:2074-81.
12. Kowal K, Pampuch A, Kowal-Bielecka O, LM Dubuske, A. Bodzenta-kukaszyk. Platelet activation in allergic asthma patients during allergen challenge with Dermatophagoides pteronyssinus. Clin Exp Allergy 2006; 36:426-32.
13. Knauer KA, Lichtenstein LM, Adkinson NF, Fish JE. Platelet activation during antigen-induced airway reactions in asthmatic subjects. N Engl J Med 1981; 304:1404-7.
14. Bath PM, Butterworth RJ. Platelet size: measurement, physiology and vascular disease. Blood Coagul Fibrinolysis 1996; 7:157-61.
15. Kasperska-Zajac A, Rogela B. Markers of platelet activation in plasma of patients suffering from persistent allergic rhinitis with or without asthma symptoms. Clin Exp Allergy 2005; 35:1462-5. doi: 10.1111/j.1365-2222.2005.02357.x.
16. Kasperska-Zajac A, Rogala B. Platelet activity measured by plasma levels of beta- thromboglobulin and platelet factor 4 in seasonal allergic rhinitis during natural pollen exposure. Inflamm Res 2003; 52:477-9.
17. Akgedik R, Yağız Y. Is Decreased Mean Platelet Volume in Allergic Airway Diseases Associated With Extent of the Inflammation Area? Am J Med Sci 2017; 354:33-38. doi: 10.1016/j.amjms.2017.04.001. Epub 2017 Apr 6.
18. Kasperska-Zajac A, Brzoza Z, Rogala B. Seasonal Changes in Platelet Activity in Pollen-Induced Seasonal Allergic Rhinitis and Asthma. Journal of Asthma 2008; 45:485-7.
19. Chen Y, Zhou L, Yang Y. Effect of sublingual immunotherapy on platelet activity in children with allergic rhinitis. Braz J Otorhinolaryngol 2017; 83:190-4.