Reduction in mean platelet volume in children with acute bronchiolitis

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Abstract

Aim: Platelets which are known to play a role in inflammation change their shapes when they are activated and this change is reflected in mean platelet volume and platelet distribution width values. Therefore, the mean platelet volume and platelet distribution width values are considered to be beneficial parameters for the diagnosis and treatment of many inflammatory diseases. The aim of the study was to evaluate platelet volume indices in children with acute bronchiolitis.

Material and Methods: A total of 514 infants who were below the age of 2 years old were evaluated in this study. Three hundred thirteen of these infants were diagnosed with acute bronchiolitis patients and 201 were healthy children. The patients were separated into four groups as mild, moderate, severe bronchiolitis and the control patient group. The groups were evaluated in terms of significant differences in the values of mean platelet volume and platelet distribution width. A p value of <0.05 was considered statistically significant for all results.

Results: The mean platelet volume was found to be 6.8 ± 0.6 fL in the patients with mild bronchiolitis attack, 6.7 ± 0.6 fL in the patients with moderate bronchiolitis attack, 6.5 ± 0.5 fL in the patients with severe bronchiolitis attack and 7.3 ± 1.1 fL in the control group. The mean platelet volume was statistically significantly lower in the mild, moderate and severe bronchiolitis attack groups compared to the control group ($p=0.000$). The platelet distribution width was found to be $17.2\% \pm 0.83$ in the mild bronchiolitis attack group, $17.1\% \pm 0.96$ in the moderate bronchiolitis attack group, $17.3\% \pm 0.87$ in the severe bronchiolitis attack group and $16.9 \pm 1.6\%$ in the control patient group. This difference was not statistically significant ($p=0.159$). The platelet count was statistically significantly higher in the mild, moderate and severe bronchiolitis attack groups compared to the control group ($p=0.000$).

Conclusions: The mean platelet volume is decreased in patients with acute bronchiolitis. It is not a useful criterion in determining the severity of bronchiolitis attack. It is important that clinicians evaluating hemogram results to also interpret this variable.
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Keywords: Bronchiolitis, inflammation, mean platelet volume, platelet distribution width

Introduction

Platelets are discoid cells which show variability in terms of volume, intensity, age and metabolic functions. They play an important role not only in hemostasis, but also in angiogenesis, inflammation, allergic reactions and repair and renewal of tissues and contain mediators which lead to strong inflammatory response (1). The platelet volume is specified during formation of platelets from megakaryocytes in the bone marrow. No maturation occurs in the platelets in the circulation. Therefore, factors stimulating the bone marrow including inflammation and infection may lead to changes in the platelet volume and number. When the bone marrow is stimulated, production of the platelets increases

and the diameters of the young platelets produced are larger compared to the mature platelets. This results in an increase in mean platelet volume (MPV) and platelet distribution width (PDW). These changes in MPV are observed before the changes in the platelet number (2, 3). Therefore, it has been thought that the change in MPV might be beneficial to detect inflammation in the early period (4).

Although platelet volume variables are being calculated in complete blood count for a long time, the relation between different diseases and platelet volume variables has attracted attention in recent years. According to the literature, platelet volume indices may be used in detection of inflammation, in detection of the prog-

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nosis and active periods of diseases and in specifying the efficiency of treatment (4-7). Mean platelet volume shows the mean volume of the platelets in the circulation. Platelet distribution width which is another index reflects the difference between platelet diameters. Changes in both measurements may be observed when platelets are activated and change shape (3).

In many inflammatory and infectious diseases, changes in MPV and PDW have been reported (4). A reduction in MPV has been frequently found in inflammatory diseases. Mean platelet volume was found to be lower by Kisacik et al. (4) in patients with ankylosing spondylitis and rheumatoid arthritis, by Soyuncu et al. (5) in patients with systemic sclerosis and by Öztürk et al. (6) in patients with inflammatory bowel disease compared to healthy individuals.

Changes in platelet volume indices have been also found in infectious diseases. It was found that the MPV and PDW values were higher in patients with sepsis compared to the patients who did not have sepsis and these indices might be helpful indices in predicting survival in sepsis (7, 8). Platelets also play an important role in allergic diseases. Thromboxan A₂ which has an important role in platelet efficiency and allergic response is required for production of leukotrienes and lipoxins from arachidonic acid. Platelets are involved in all steps including obstruction in the airways, airway inflammation and bronchial hypersensitivity in asthma. In patients with asthma, an increase in MPV has been found during asthma attack (9).

Platelet volume indices which are known to change in inflammatory, infectious and allergic diseases may be helpful measurements in evaluation of patients with acute bronchiolitis arising from inflammatory obstruction of small airways characterized with bronchial inflammation who constitute a significant part of hospitalizations in the childhood.

We could not find any study related with platelet volume indices in acute bronchiolitis. In this study, it was aimed to evaluate platelet volume indices which are routinely tested in complete blood count which is frequently obtained during hospitalization in patients hospitalized with a diagnosis of acute bronchiolitis. These indices which do not need additional cost are frequently ignored by physicians.

Material and Methods

This study was conducted between January 2012 and January 2013. A total of 514 children including 313 patients and 201 healthy children were included in the

study. The patient and control groups were created by retrospective examination of file records. The control group consisted of the children who presented to our healthy child outpatient clinic and who were not found to have any morbidity at presentation and the patient group consisted of the patients who were hospitalized in our infancy ward with a diagnosis of bronchiolitis. The patient group was divided into three groups including mild, moderate and severe bronchiolitis attack groups according to nutritional status, presence of apnea, presence of retractions and cyanosis, pulse and respiratory rate and saturation level. The patients who had mild retractions, who did not have cyanosis or apnea, whose respiratory rate was below 50/min and pulse rate was below 140/min and whose saturation was above 93% at presentation were considered to have mild bronchiolitis attack. The patients who did not have apnea, who had moderate retractions, whose respiratory rate was 50-70/min and pulse rate was 140-160/min and whose saturation was 88-92% at presentation were considered to have moderate bronchiolitis attack. The patients who had apnea and cyanosis, who had severe retractions, whose respiratory rate was above 70/min and pulse rate was above 160/min and whose saturation was below 85% at presentation were considered to have severe bronchiolitis attack. The MPV, PDW, WBC and platelet count values found in the complete blood count performed with BC 6 800 Mindray device in the blood sample obtained on the first day of hospitalization before treatment in the patient group were recorded, retrospectively. It was specified if there was statistically significant difference between the patient and control groups and between the patient groups in terms of these values. Ethics committee approval was obtained from the Erciyes University Medical Faculty Ethics Committee on 05.08.2012 with the decision number of 2012/356.

Statistical analysis

IBM SPSS Statistics 21.0 (SPSS Inc.; Chicago, IL, USA) program was used for statistical analysis. Kolmogorov-Smirnov test was used to determine if the data were distributed normally. In statistical evaluation, parametric tests were used for the data which showed a normal distribution and nonparametric tests were used for the data which did not show a normal distribution. The results were expressed as mean±standard deviation for parametric data and as median (the minimum-the maximum) for nonparametric data.

One Way Anova test was used in comparison of the parametric data of more than two groups and Tukey test was used in Post Hoc analysis. Kruskal Wallis variance analysis was used in comparison of nonparametric data and Dunn test was used in Post Hoc analysis. A

Table 1. Comparison of the demographic data of the patient groups and control group

	Mild (n=107)	Moderate (n=152)	Severe (n=54)	Control group (n=201)	p
Gender (n)	47/60	56/96	17/37	87/114	0.28*
Female/male (%)	(43.9/56.1)	(36.8/63.2)	(31.5/68.5)	(43.3/56.7)	
Age (months) Median (the lowest-the highest)	8 (4-13)	7.2 (4-13)	7 (3-11)	8 (6-11)	0.18**

*Chi-square test was used, a p value of <0.05 was considered statistically significant.

**Kruskal Wallis test was used, a p value of <0.05 was considered statistically significant.

Table 2. Comparison of the mild, moderate and severe bronchiolitis attack groups and control group in terms of mean platelet volume, platelet distribution width, platelet count and white blood cell count

	Mild (n=107)	Moderate (n=152)	Severe (n=54)	Control (n=201)	p
MPV (fL) Mean±SD	6.8±0.6 ^d	6.7±0.6 ^d	6.5±0.5 ^d	7.3±1 ^{abc}	0.000*
PDW (%) Mean±SD	17.2±0.83	17.1±0.96	17.3±0.87	16.9±1.6	0.159*
Platelets (x10 ³ /mm ³) Median (the lowest-the highest)	379 (165-752) ^d	385 (145-867) ^d	370 (190-714) ^d	330 (133-574) ^{abc}	0.000**
WBC (x10 ³ /mm ³) Mean±SD	12.2±4.03 ^d	11.4±4.3 ^d	12.3±4.7 ^d	8.9±1.8 ^{abc}	0.000*

WBC: white blood cells; MPV: mean platelet volume; PDW: platelet distribution width

*One Way Anova test was used, Tukey test was used in Post Hoc analysis, a p value of <0.05 was considered statistically significant.

**Kruskal Wallis test was used, Dunn test was used in Post Hoc analysis, a p value of <0.05 was considered statistically significant.

^a: shows difference compared to the mild attack group; ^b: shows difference compared to the moderate attack group; ^c: shows difference compared to the severe attack group; ^d: shows difference compared to the control group.

p value of <0.05 was considered statistically significant for all results.

Results

Two hundred and seven (40.3%) of all children included in the study were female and 307 (59.7%) were male. The median age was eight (1-24) months. In the mild bronchiolitis attack group, 47 (43.9%) of the children were female and 60 (56.1%) were male and the median age was 8 (1-24) months. In the moderate bronchiolitis attack group, 56 (36.8%) were female and 96 (63.2%) were male and the median age was 7.2 (1-24) months. In the severe bronchiolitis attack group, 17 (31.5%) of the children were female and 37 (68.5%) were male and the median age was 7 (1-22) months. In the control group, 87 (43.3%) of the children were female and 114 (56.7%) were male and the median age was 8 (2-24) months. There was no statistically significant difference between the four groups in terms of gender and age ($p>0.05$, Table 1). Mean platelet volume was statistically significantly lower in the mild, moderate and severe bronchiolitis attack groups compared to the control group ($p<0.05$, Table 2).

While no difference was found between the mild, moderate and severe bronchiolitis attack groups in terms of white blood cell count and platelet count ($p>0.05$, Table 2), a statistically significant difference was found when these groups

were compared with the control group ($p<0.001$, Table 2). No difference was found between the four groups in terms of PDW ($p>0.05$, Table 2). Mean platelet volume was lower and platelet count and WBC were higher in the mild, moderate and severe bronchiolitis attack groups compared to the control group ($p<0.05$, Table 2).

Discussion

Mean platelet volume is measured routinely in complete blood count and reflects the average volume of the platelets found in the circulation (1). Inflammatory, infectious and allergic conditions cause to an increase in the production of platelets by stimulating the bone marrow and cause larger young platelets to get into the circulation. Therefore, an increase in the platelet count and MPV is observed in complete blood count. The increase observed in MPV occurs before the increase in the platelet count (2). Since platelets have a significant role during inflammation, the platelet count is increased in many inflammatory diseases (10). In our study, the platelet count was found to be statistically significantly higher in the patients who had acute bronchiolitis compared to the healthy children (Table 2, $p<0.05$). We attribute this finding to bronchial inflammation which develops in acute bronchiolitis.

Another finding of us was that the MPV value was lower in the patients with acute bronchiolitis compared

to the healthy children (Table 2, $p < 0.05$). Mean platelet volume has been evaluated in many conditions in the literature. However, studies have frequently shown controversial results. Dogru et al. (9) found MPV to be higher in patients with asthma compared to healthy individuals. Tuncel et al. (11) compared the MPV values between patients who had asthma attack and healthy individuals and found no significant difference between the two groups. Sun et al. (12) found MPV to be lower in patients with asthma compared to the healthy group. It is possible to obtain different results in studies performed in relation with the same condition. For example, MPV was found to be higher in the patient group in a study conducted by Makay et al. (13) with patients with familial Mediterranean fever and to be lower in a study conducted by Sahin et al. (14) with patients who had the same morbidity.

We could find no study evaluating the relation between acute bronchiolitis and MPV in the literature. In our study, MPV was found to be lower in the patients who had acute bronchiolitis compared to healthy children. Renshow et al. (15) found MPV to be lower in patients hospitalized because of infection with respiratory syncytial virus which is a common virus which causes to bronchiolitis compared to the control group. An increase in the number of young platelets and in MPV is expected with activation of platelets in case of inflammation. However, a reduction in MPV has been found in many studies related with inflammatory diseases. The reason for decreased MPV can not be explained fully in many conditions (4-7). The finding that the MPV value was lower in the patients with acute bronchiolitis compared to the healthy children in our study may be related with inflammation. Although platelets are activated during inflammation, reduction in the MPV value may be related with migration of large young platelets to the site of inflammation and a relative decrease in the circulation. Although the decrease in the MPV value can not be explained clearly, inflammatory conditions lead to changes in the platelet membrane and internal structure. It has been reported that depolymerization occurs in the microtubular structure of the platelets and changes occur in the structure of actin polymerization during inflammation and as a result, platelets change their shapes and this change is reflected in the MPV value (16).

Thus, MPV also changes in infectious events as well as in inflammatory conditions. In studies conducted with patients hospitalized with a diagnosis of pneumoniae, MPV has been found to be higher compared to healthy children (17). In patients with sepsis, MPV has been found to be higher compared to healthy individuals. Mean platelet volume was found to be higher in pa-

tients who died because of sepsis compared to the ones who survived and it was proposed that MPV was an important index in specifying the severity of sepsis and the mortality risk (8, 18).

Not only presence of inflammation, but also its severity is efficient in specifying the platelet diameter. According to Gasparyan et al. (19), the platelet diameter and thus MPV increase in mild inflammation, but MPV measurement which shows only the mean volume of the platelets found in the circulation decreases because activated large platelets migrate to the site of infection when inflammation progresses and its severity increases. This suggests that the severity of inflammation may be a determinant of the MPV value. Therefore, it has been stated that MPV may be used in determining the disease prognosis and severity in many conditions. In the study conducted by Yüksel et al. (20), the MPV value was found to be lower in the patients with inflammatory bowel disease who were in the active period compared to the ones who were not in the active period and accepted MPV to be a marker indicating disease activity. Liu et al. (21) found MPV to be lower in patients with incomplete Kawasaki compared to the ones who had complete Kawasaki. In the study conducted by Sakallı et al. (22) with patients who had familial Mediterranean fever, the MPV value was found to be higher in the patients who had proteinuria compared to the ones who did not have proteinuria. Akarsu et al. (18) found MPV to be lower in the patients who died because of neonatal sepsis compared to the ones who survived and proposed that MPV could be a prognostic measurement in sepsis. In our study, no statistically significant difference was found between the mild, moderate and severe bronchiolitis attack groups in terms of MPV (Table 2, $p < 0.05$).

Change in the MPV value has also been used in follow-up of patients. Kisacik et al. (4) found MPV to be low in patients with active ankylosing spondylitis and rheumatoid arthritis and showed that an increase occurred in MPV with treatment. In our study, we did not evaluate MPV after treatment. It can be identified if MPV is a helpful measurement also in the follow-up of patients with a further study in which MPV values before and after treatment are measured.

Platelet distribution width which is another platelet volume index shows the variability between platelet diameters and this depends on platelet activation (23). An increase in PDW may occur as a result of swelling, disruption and immaturity in platelets (3). A change in platelet volume results in an increase in PDW. Increase in PDW is related with an increase in the immature platelets in the circulation as a result of stimulation of

the bone marrow during inflammation and activation of platelets due to inflammation. In the study of Akarsu et al. (18) conducted with patients who had neonatal sepsis, PDW was found to be higher in the group in which mortality occurred compared to the healthy group and it was proposed that PDW could indicate prognosis in sepsis. Similarly, Guclu et al. (7) found an increase in PDW in patients with sepsis and found PDW to be higher in the group in which mortality was observed. We found no statistically significant difference between the patients who had bronchiolitis attack and the control group in terms of PDW (Table 2, $p>0.05$).

In conclusion, MPV does not seem to be a helpful measurement in specifying the severity of acute bronchiolitis attack according to our study. However, MPV was found to be lower in children hospitalized with a diagnosis of acute bronchiolitis compared to healthy children. Therefore, clinicians who evaluate complete blood count which is frequently ordered should not ignore interpreting the MPV value.

Ethics Committee Approval: Ethics committee approval was received for this study.

Informed Consent: Written informed consent was not obtained from patients due to the retrospective nature of this study.

Peer-review: Externally peer-reviewed.

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