CHANGES IN MPV, PCT AND OTHER LABORATORY PARAMETERS IN CHILDREN WITH ADENOVIRUS GASTROENTERITIS

ADENOVİRÜS GASTROENTERİTLİ ÇOCUKLARDA MPV, PCT VE DİĞER LABORATUVAR PARAMETRELERİNDEKİ DEĞİŞİKLİKLER

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Öz

Amaç: Enterik adenovirüsler çocuklarda akut ve uzamış ishal nedeni olarak rota virüslerden sonra en sık görülen ikinci viral gastroenterit ajanıdır. Ortalama trombosit hacmi (MPV), trombosit fonksiyon ve aktivasyonu gösteren bir belirteçtir. MPV, farklı inflamatuar ve enfeksiyöz durumlarda, sistemik inflamasyonun şiddetine göre artış ya da azalış gösterebilmektedir. Bu çalışmanın amacı; adenovirüs gastroenteriti olan çocuklarda bazı trombosit indekslerinde ve diğer laboratuvar parametrelerindeki değişikliklerin değerlendirilmesidir. Gereç ve Yöntem: Adıyaman Kamu Hastaneleri Birliği Genel Sekreterliği'ne bağlı ilçe sağlık tesislerinde Ocak 2014 - Aralık 2016 tarihleri arasında akut adenovirüs gastroenteriti tanısı konularak klinikte takibe alınan 5 yaş altı 61 hasta ile 64 sağlıklı kontrol çalışmaya alındı. Bulgular: Adenovirüs gastroenteriti olan 61 çocuğun 29'u kız, 32'si erkek olup hastaların yaş ortalaması 23.70 ±18.8 ay (2-60). Sağlıklı 64 çocuktan oluşan kontrol grubunun ise; 29'u kız, 35'i erkek olup, yaş ortalaması 24,87±14,81 ay (1-54). PCT ile PLT arasında ise pozitif yönde anlamlı ve yüksek derecede korelasyon tespit edildi. WBC, HGB, AST' nin tanısal ayırt ediciliğinin olabileceği tespit edildi. Ayrıca adenovirüs gastroenteritinde PCT'nin ve MPV'nin tanısal ayırt ediciliğinin olmadığı tespit edildi. Tartışma: Adenovirüs gastroenteritli hastalarda MPV değeri kontrol grubu ile karşılaştırıldığında anlamlı olarak düşük bulundu. Bu nedenle MPV'nin adenovirüs gastroenteritlerinde negatif akut faz reaktanı olarak kullanılabileceği düşünüldü.

Anahtar Kelimeler

Ortalama Trombosit Hacmi; PCT; Adenovirus; Gastroenterit

Abstract

Aim: Enteric adenoviruses are the second most common cause of acute and prolonged diarrhea due to viral gastroenteritis after rotaviruses. Mean platelet volume (MPV) is a marker of platelet function and activation. MPV can increase or decrease based on the severity of systemic inflammation in various inflammatory and infectious conditions. The aim of this study was to evaluate the changes in some platelet indices and other laboratory parameters in children with adenovirus gastroenteritis. Material and Method: A total of 61 patients aged under 5 years who were diagnosed with acute adenovirus gastroenteritis in the county healthcare facilities affiliated with the Adiyaman General Secretariat of Public Hospitals between January 2014 and December 2016 and clinically followed-up at the clinic were included in the study together with 64 healthy control subjects. Results: The 61 patients with adenovirus gastroenteritis consisted of 29 females and 32 males with a mean age of 23.70 ±18.8 (2-60) months. The 64 healthy children in the control group consisted of 29 females and 35 males with a mean age of 24.87±14.81 (1-54) months. We found a significant and highly positive correlation between PCT and PLT. WBC, HGB, AST were found to have potential value for the differential diagnosis. We also found that PCT and MPV had no diagnostic value in the differential diagnosis of adenovirus gastroenteritis. Discussion: The MPV value was significantly lower in the adenovirus gastroenteritis patients than the control group. We therefore believe that MPV could be used as a negative acute phase reactant in adenovirus gastroenteritis.

Keywords

Mean Platelet Volume; PCT; Adenovirus; Gastroenteritis

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Introduction

Adenoviruses are double-stranded DNA viruses of the Adenoviridiae family. They have seven types from A to G with more than 50 serotypes and can infect many tissues such as the respiratory system, the eye and the gastrointestinal system [1,2]. Enteric adenoviruses are the second most common cause of acute and prolonged diarrhea due to viral gastroenteritis after rotaviruses. Pediatric gastroenteritis is known to cause severe symptoms and signs such as nausea, diarrhea, electrolyte imbalance and even death, especially in small children and infants [3-5]. Epidemics of adenovirus gastroenteritis can occur as virus excretion continues for a short time after recovery [6].

Mean platelet volume (MPV) is a marker reflecting platelet activation and function and can be easily measured by routine whole blood count devices [7,8]. Platelets are known to have an important role in the pathogenesis of diseases associated with local or systemic inflammation [9,10]. MPV has been shown to increase or decrease in various infectious and inflammatory disorders [11,12]. Changes in MPV and platelet functions have been reported in gastroenteritis cases due to rotavirus, Entamoeba histolytica and non-infectious agents. However, we did not come across any previous studies on the MPV response in adenovirus gastroenteritis. This is the first study in the literature evaluating the effect of adenovirus gastroenteritis on platelet function parameters in laboratory tests performed at intake. The aim of the study was to compare MPV values and other laboratory tests in adenovirus gastroenteritis patients and a control group under the age of 5, and also to investigate whether MPV and PTC values have diagnostic value in adenovirus gastroenteritis.

Material and Method

A total of 125 cases, under the age of 5 years, consisting of 61 patients who had presented to the pediatric outpatient department at the county healthcare facilities affiliated with the Adıyaman General Secretariat of Public Hospitals between January 2014 and December 2016 with a symptom of diarrhea and who were diagnosed with acute adenovirus gastroenteritis and clinically followed-up and 64 healthy control subjects were included in this retrospective, controlled and sectional study. The data in the hospital information management system of adenovirus gastroenteritis patients and the healthy children seen between the above dates were retrospectively reviewed and the results of the laboratory tests conducted at presentation were statistically analyzed. In total, the data of 3397 children under the age of 5 years who presented to the relevant health institution between January 2014 and December 2016 due to diarrhea were reviewed. We excluded patients with a history of drug use (antibiotics or other drugs), anemia, co-infection, chronic disease, and those with no adenovirus on fecal analysis or where other factors were found on macroscopic/microscopic fresh stool analyses or stool culture samples, leaving 61 adenovirus gastroenteritis cases in the patient group. The control group consisted of 64 age-matched healthy children who presented to the same healthcare institution for a routine check. The necessary official permissions and the ethics committee approval were obtained from the relevant institutions before the study. Demographic characteristics, whole blood count (CBC) and C-reactive protein (CRP) values and other biochemical test results at presentation of all children included in the study were evaluated. Our aim was to compare MPV values between the two groups and to investigate the diagnostic value of MPV as a marker in adenovirus gastroenteritis.

We only included the data of the cases where the CBC analysis results were available within 45 minutes of drawing the venous blood. The volume impedance method on the Abbott Cell-Dyn 3700 hematology analyzer system (Abbott Diagnostics Image 3700SL) was used with standard tubes containing a fixed amount of K3-EDTA for the CBC analyses. CRP levels were measured with the turbidimetric experiment method using the Abbott Architect 4000 system and the Abbott 8000 modular system (Abbott Diagnostics, architect c4000 and architect c8000). The constant variables obtained from the study were expressed as mean ± standard deviation and median (minimum-maximum) and the categorical variables as n (%). The chi-square test was used in the analysis of categorical variables. A statistically significant difference in terms of constant variables was being tested between the groups and the compliance of the variables with the normality assumption was checked and appropriate tests were used. The tests used depending on the distribution were the t-test or the non-parametric alternative, the Mann-Whitney U test for independent groups. We used Pearson's correlation test for data with a normal distribution and Spearman's correlation test for those without. ROC analysis was conducted to determine the diagnostic value of the parameters. When a cut-off value could not be identified, the normal limits of the parameters were used and accuracy criteria were obtained from the variable that had been made categorical. A $p < 0.05$ was accepted as statistically significant for the determined differences. The IBM SPSS ver. 20 software program was used for data analysis.

The study was initiated upon approval by the Local Ethics Committee of Fırat University in accordance with the Helsinki Declaration.

Results

The 61 children with adenovirus gastroenteritis (Group-1) consisted of 29 (47.5%) females and 32 (52.5%) males with a mean age of 23.70 ±18.8 (2-60) months. The 64 healthy children (Group-2) consisted of 29 (45.3%) females and 35 (54.7%) males and the mean age was 24.87 ±14.81 (1-54) months. Evaluation of the gender revealed that the female and male ratios were statistically similar between the groups (p=0.803). In this study, there was no statistically significant difference in term of age ratios between the two groups (p=0.312). The MPV value was significantly lower in adenovirus gastroenteritis patients than in the control group (p = 0.048). While WBC and AST values were significantly higher in Group-1 compared to the control group ($p<0.05$), the HGB value was significantly lower (p=0.021). The mean values of the laboratory parameters in the study groups are presented as mean±SD and mean (min-max) in Table 1.

The correlation tests showed a significant but weak positive correlation between PCT and the WBC and BUN values (p=0.001; p=0.036, respectively); a significant and highly positive correlation between PCT and PLT ($p <0.001$); and a significant but weak

Table 1. The disturibution of laboratory parameters of patients and control groups

Parameters	Group 1 Mean±SD Med(Min-Max)	Group 2 Mean±SD Med(Min-Max)	P
PCT (%)	0.26±0.10	0.25±0.06	0.479
	0.24(0.08-0.63)	0.26(0.01-0.38)	
MPV (fl)	8.32±1.92	8.85±0.79	0.048*
	8.30(3.95-13.20)	9.00(7.20-10.50)	
WBC (103 /µL)	9.87±3.28	7.60±1.44	<0.001*
	9.92(3.60-17.60)	7.75(3.94-9.93)	
HGB (g/dL)	11.93±1.32	12.39±0.83	0.021*
	11.80(7.95-14.30)	12.30(11.10-14.30)	
PLT (103 /µL)	307.07±111.10	287.5±59.02	0.224
	286.00(124.00-641.00)	295.00(160.00-381.00)	
CRP (mg/L)	0.57±0.58	0.51±0.88	0.094
	0.38(0.02-2.10)	0.21(0.01-5.67)	
BUN (mg/dL)	16.41±7.01	15.56±5.45	0.449
	17.00(1.86-35.00)	14.00(3.00-26.00)	
KREATININ (mg/dL)	0.40±0.10	0.36±0.11	0.072
	0.40(0.15-0.61)	0.35(0.13-0.59)	
ALT (U/L)	19.78±8.30	21.83±7.90	0.063
	16.00(10.00-44.00)	20.50(9.00-44.00)	
AST (U/L)	36.02±12.45	26.83±9.72	<0.001*
	34.00(19.00-87.00)	26.00(6.00-41.00)	

The data presented as mean ± SD . *P < 0.05 statistical significant
PCT: Plateletcrit. MPV: Mean Platelet Volume. WBC: White Blood Cell Count. Hgb: Hemoglobin. PLT: Platelet Count. CRP: C-Reaktif Protein. BUN: Blood Urea Nitrogen. AST: Aspartat Aminotransferaz. ALT: Alanin Aminotransferaz.

negative correlation between PCT and creatinine (p =0.009) in group-1. We also found a positive correlation between MPV and ALT and a significant but weak negative correlation between MPV and creatinine (p= 0.003; p<0.001, respectively). Correlation test analysis results are presented in Table 2.

Table 2. The relationship of with other blood parameters of PCT and MPV

Parameters	PCT r(p)	MPV r(p)
WBC (103 /µL)	0.28 (0.001)*	-0.13 (0.156)
HGB (g/dL)	-0.10 (0.280)	-0.11 (0.210)
PLT (103 /µL)	0.76 (<0.001)*	-0.16 (0.074)
CRP (mg/L)	0.02 (0.816)	0.06 (0.508)
BUN (mg/dL)	0.19 (0.036)*	0.09 (0.327)
KREATININ (mg/dL)	-0.232 (0.009)*	-0.315 (<0.001)*
ALT (U/L)	0.152 (0.091)	0.26 (0.003)*
AST (U/L)	0.03 (0.706)	-0.12 (0.172)

r: Correlation coefficient. *P < 0.05 statistical significant
PCT: Plateletcrit. MPV: Mean Platelet Volume. WBC: white blood cell count. Hgb: Hemoglobin. PLT: Platelet Count. CRP: C-reaktif protein. BUN: Blood Urea Nitrogen. AST: Aspartat Aminotransferaz. ALT: Alanin Aminotransferaz.

ROC analysis was conducted to identify whether MPV and some other parameters had diagnostic value in adenovirus gastroenteritis. ROC analysis showed PCT (AUC=0.483; p=0.746; 95% CI: 0.379-0.588) and MPV (AUC=0.402; p=0.059 95% CI: 0.296-0.508) did not have differential diagnostic value while WBC (AUC=0.705; p=0.001, 95% CI: 0.609-0.802), HGB (AUC=0,389; p=0.033, 95% CI: 0.287-0.491) and AST (AUC=0.709; p=0.001, 95% CI: 0.620-0.798) did. ROC analysis results for MPV and the other parameters are presented in Figure 1.

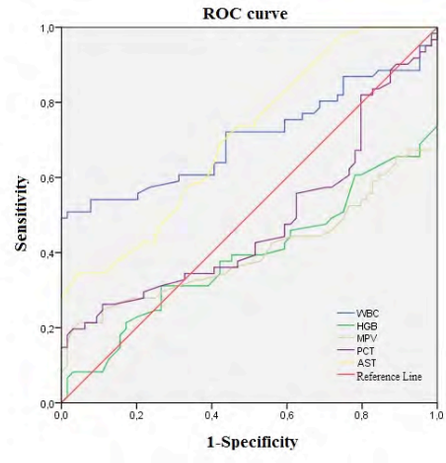


Figure 1. The ROC curve analysis of MPV, PCT and other laboratory parameters

The MPV parameter that was made categorical by using the normal limits in the literature was seen to create a statistically significant difference on cross-tabulation of the groups and accuracy criteria were obtained. We found that the categorical state of the MPV parameter based on its normal limits (7.2-11.1 fl) could be used in the diagnosis and 100% of healthy individuals were classified correctly (sensitivity 39.3%, specificity: 100%, positive predictive value: 100%, negative predictive value: 63.4%). We also determined the relative values for the parameters of WBC (sensitivity 47.5%, specificity: 98.4%, positive predictive value: 96.7%, negative predictive value: 66.3%) and AST (sensitivity 27.9%, specificity: 100%, positive predictive value: 100%, negative predictive value: 27.9%).

Discussion

The MPV value was found to be significantly lower in patients with adenovirus gastroenteritis than in the control group. A positive relationship was shown between MPV and AST. WBC, HGB and AST did not show value for use in the differential diagnosis.

There is no previous study on MPV levels in adenovirus gastroenteritis patients in the literature. We found two studies on MPV levels in rotavirus gastroenteritis, two on MPV levels in patients infected with Entamoeba histolytica and one study on MPV levels in children with infectious and non-infectious diarrhea [13-17]. Mete et al. and Çelik et al. reported decreased MPV values in patients with rotavirus gastroenteritis and suggested using MPV as a negative acute phase reactant [13,14]. Çelik et al. found increased MPV values while Matowick-Karna et al. reported decreased MPV levels in acute gastroenteritis due to Entamoeba histolytica [16,17]. Additionally, Küçük et al. reported the MPV values in patients with acute bacterial diarrhea to be higher than in patients with non-infectious and viral diarrhea [15]. MPV values in children with adenovirus gastroenteritis were found to be lower than in the control group in this study as in studies by Mete et al. and Çelik et al. [13,14]. However, Turhan et al. found MPV values in patients with inac-

tive hepatitis B to be higher than in the control group [18]. Ekiz et al. showed thrombocytopenia and increased MPV in Crimean Congo Hemorrhagic Fever (CCHF) when compared with the control group [19]. Aydemir et al. found a significant increase in the MPV value within the first three days in gram-negative sepsis patients [20].

All these studies demonstrate that MPV can increase or decrease according to the severity of the systemic inflammation in various inflammatory and infectious situations. Although the exact mechanism is unknown, it is believed that MPV can increase in low grade inflammation due to the presence of large platelets in the circulation, whereas it can decrease due to the consumption of these large platelets in the vascular segment of the inflammation area in case of severe inflammation [11-13]. The decrease in the MPV level observed in studies conducted on inflammatory gastrointestinal diseases such as acute appendicitis, acute gastroenteritis, intestinal tuberculosis and inflammatory intestinal disorders can support this hypothesis, but new studies on larger populations and other inflammatory disorders where inflammation markers are also evaluated are required. CD62, CD63, GPIIb/IIIa, PF4 and thromboglobulin are tests that show platelet activation but are not included in routine analyses as they require special equipment and have high cost [21]. However, MPV measurement is a low-cost, highly efficient and useful method showing platelet function and activation that can easily be included in the whole blood count in most medical facilities [7,8]. When all these advantages are considered, MPV can be recommended as a positive or negative marker in inflammatory and infectious diseases.

A significant and strong positive correlation was found between PCT and PLT and a significant but weak negative correlation between PCT and creatinine in Group-1 in the correlation test conducted in this study. Also, a positive correlation between MPV and ALT and a significant but weak negative correlation between MPV and creatinine were found. We found that PCT and MPB had no differential diagnostic value in adenovirus gastroenteritis but WBC, HGB and AST could help the differential diagnosis in the ROC analysis conducted.

A decrease in MPV value was found in children with adenovirus gastroenteritis when compared to the control group in this study. We also found that PCT and MPV had no diagnostic value but WBC, HGB and AST could help the differential diagnosis in adenovirus gastroenteritis. MPV can be used as an acute phase reactant in children with acute gastroenteritis as MPV measurement is an inexpensive and useful test that can easily be performed in most medical facilities.

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Competing interests

The authors declare that they have no competing interests.

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