

Research Article

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## Mean Platelet Volume: A Useful Marker in Reflux Nephropathy

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### Introduction

Mean platelet volume (MPV) represents the size of the platelets in a blood sample. This index is used to determinate the rate of platelet production in patients who suffer from problems or diseases related to platelet destruction or bone marrow. The volume of the platelets is calculated in femtoliter (fL), which ranges between 7.5 and 11.5 fL under normal circumstances. A platelet count shows whether a person is producing normal amounts of these cell fragments. If the count is

**Introduction:** The inflammatory reaction caused by a pyelonephritis infection can result in renal injury or scarring, which is also termed reflux-related renal injury or reflux nephropathy. The importance of platelet changes is emphasized in some chronic diseases. In this study, the changes of mean platelet volume (MPV) and mean platelet count (MPC) were investigated in children with reflux nephropathy.

**Materials and Methods:** In this case-control study, 107 females with vesicoureteral reflux (VUR) (grade 1 to 3) and reflux nephropathy and 107 females with VUR (grade 1 to 3) without reflux nephropathy were included. Demographics characteristics of the patients were recorded and laboratory parameters in the active phases of first pyelonephritis were evaluated.

**Results:** MPC was higher in patients with reflux nephropathy than non-reflux nephropathy patients and MPV was lower in the patients with reflux nephropathy than patients without reflux nephropathy.

**Conclusions:** MPV can be used as an indicator in diagnosis of reflux nephropathy in patients with VUR.

**Keywords:** Mean Platelet Volume; Vesico-Ureteral Reflux; Child.

**Running Title:** Mean Platelet Volume in Reflux Nephropathy

lower or higher than normal, it may be a sign of a blood or bone marrow disorders. A high Platelet Count and low MPV indicate increased production of platelets, A low platelet count may indicate a form of anemia, or may result from therapy involving treatment with drugs that are toxic to cells such as chemotherapy. Low MPV may indicate chronic kidney failure and its combination with a high platelet count may suggest an infection, inflammation or some forms of cancer [1,2]. Vesicoureteral reflux (VUR) refers

to the retrograde flow of the urine from the bladder to the ureter and kidney [3]. The ureteral attachment to the bladder is normally oblique, between the bladder mucosa and detrusor muscle, creating a flap- valve mechanism that prevents reflux [4,5]. Reflux occurs when the sub mucosal tunnel between the mucosa and detrusor muscle is short or absent. Reflux predisposes the person to infection of the kidney by facilitating the transport of bacteria from the bladder to the upper urinary tracts [6].

If the bacteria ascend from the bladder to the kidney, acute pyelonephritis can occur. Normally, simple and compound papillae in the kidney have an antireflux mechanism that prevents urine in the renal pelvis from entering the collecting tubules. However, some compound papillae, typically in the upper and lower poles of the kidney, allow intrarenal reflux. Infected urine then stimulates an immunologic and inflammatory response. The result can cause renal injury and scarring. Children of any age with a febrile UTI may have acute pyelonephritis and subsequent renal scarring, but the risk is highest in children <2 years of age.

The inflammatory reaction caused by pyelonephritis can result in renal injury (reflux nephropathy (RN)). MPV is used to screen for items like infection. The mean platelet volume measurement can reflect changes in either the level of platelet stimulation or rate of platelet production [7,8]. The relationship between the platelet count and size and megakaryocyte count, size, and ploidy has been well described, the factor that regulate this interaction are still poorly understood [9]. The aim of the study was to measure MPV in children with VUR and evaluate its relationship with reflux nephropathy.

### Materials and Methods

This study evaluated the role of MPV as an inflammatory marker in children with reflux nephropathy for the first time. In this case-control study, we selected 107 children with VUR and RN as the case group and 107 children with VUR without RN as the control group, who were admitted to Amir-Kabir Hospital, Arak, Iran, with a complaint of urinary tract infection with fever (pyelonephritis). Routine hemogram and biochemical and renal function tests were performed for each patient and those with abnormal findings were excluded from the study. Normal MPV ranges from 7.2 to 10 fl. Voiding Cystourethrogram (VCUG) was performed on all

patients while Dimercaptosuccinic acid (DMSA) scan was performed on children with VUR (reflux nephropathy was documented with repeating DMSA 4 to 6 months after acute UTI).

DMSA, VCUG, and complete blood count (CBC) were evaluated by a one radiologist, nephrologist, and hematologist who were blind to clinical data of patients. Statistical analysis was performed using SPSS 17.0. Results are presented as mean  $\pm$  standard deviation.  $X^2$  and Fisher's exact tests were used for comparison between the two groups. P-values less than 0.05 were considered significant. This study was approved by the ethics committee of Arak University of Medical Sciences and the principles of the Helsinki Declaration were observed in all stages of this study. Informed written consent was obtained from all participants and they were free to withdraw from the study at any time. (This study was part of a thesis entitled "Evaluation of Predisposing Factors and Prognosis of VUR").

### Results

The mean age of the patients with reflux nephropathy was  $8:36 \pm 3.85$  years and the mean age of the VUR group without RN was  $6:91 \pm 4.11$  years.

The mean platelet count in the reflux nephropathy group ( $399,242 \pm 205,589/\text{mL}$ ) was significantly higher than the VUR group ( $298,874 \pm 71,595/\text{mL}$ ) ( $p=0.02$ ). The MPV was significantly lower in the active period of pyelonephritis when compared with the VUR group ( $8.01 \pm 1.98$  and  $7.51 \pm 2.15$  fL, respectively,  $p=0.00$ ). The MPV increased during 3 months after UTI ( $6.98 \pm 2.96$  fL). Although MPV tended to increase after treatment, it was significantly lower in patients when compared with the VUR group ( $p<0.05$ ). A significant negative correlation was found between MPV and MPC ( $p<0.005$ ).

Mean creatinine, BUN, sodium, potassium, CRP, ESR and proteinuria were similar in both groups. The mean platelet count of the reflux nephropathy group was significantly higher than the VUR group. The MPV of the reflux nephropathy group was significantly lower than the VUR group.

### Discussion

In our study MPC was higher in patients with reflux nephropathy than non-reflux nephropathy patients and MPV was lower in the patients with reflux nephropathy than patients without reflux nephropathy. The mechanism through which the

platelet count increases and MPV decreases during reflux nephropathy has not been evaluated yet. In our study, the platelet count was significantly higher and MPV was lower in reflux nephropathy versus VUR patients; moreover, reflux nephropathy patients had higher platelet counts than the other group. Song liu in 2012 reported that MPV declined in patients with Crohn's disease [8]. In a study by Huseyin Narci in 2013, MPV was higher in patients with acute appendicitis [9]. In a study by Gulsah Gunluoglu in 2014, MPV was lower in patients with pulmonary tuberculosis than healthy controls [10]. In ocular Behcet's disease, MPV is not a predictive laboratory test to determine clinical improvement following classic immunosuppressive treatment [11]. Akelma AZ evaluated the role of MPV as an inflammatory marker in children with chronic spontaneous urticaria for the first time in 2013 [12]. A decline in MPV may be considered an indicator of inflammation in children with chronic spontaneous urticaria.

### Conclusions

This study showed an apparent correlation between MPV and reflux nephropathy. A multicenter study with a larger sample size is suggested to investigate the correlation between MPV and reflux nephropathy.

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### Conflict of Interest

Authors have no conflict of interest to declare.

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