Research Article

Mean Platelet Volume as a Predictive Marker for Poor Prognosis of Acute Renal Failure in children

How to Cite This Article: Yousefichaijan P, Eghbali A, Rafiei M, et al. Mean Platelet Volume as a Predictive Marker for Poor Prognosis of Acute Renal Failure in children. J Ped. Nephrology 2015;3(3):92-94.

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Introduction: Acute renal failure (ARF) is a clinical syndrome in which a sudden deterioration in renal function results in the inability of the kidneys to maintain fluid and electrolyte homeostasis. A classification system has been proposed to standardize the definition of acute kidney injury in adults. These criteria of risk, injury, failure, loss and end-stage renal disease were given the acronym of RIFLE. Our goal was to study the mean platelet volume (MPV) as a prognostic predictor of ARF in children. Mean platelet volume (MPV) is a machine-calculated measurement of the average size of platelets in blood and typically included in blood tests as part of CBC (Complete Blood Count). Since the average platelet size is larger when the body is producing increased numbers of platelets, MPV can be used to make inferences about platelet production in bone marrow or platelet destruction problems.

Material and Methods: The records of 200 patients with ARF were investigated prospectively. Complete blood count including MPV, erythrocyte sedimentation rate, serum C-reactive protein and electrolytes of patients were measured and compared.

Results: MPV values were low in loss (p=0.0012) and failure (p<0.005). The sensitivity and specificity of MPV for the diagnosis of loss and failure were higher than those of the other inflammation markers. MPV<8.2 fL was significantly associated with poor prognosis in renal functions.

Conclusions: MPV is a fast and reliable measurement with considerable predictive value for prediction of prognosis in acute renal failure.

Keywords: Acute Kidney Injury; Mean Platelet Volume; Blood Platelets; Acute Kidney Injury; Prognosis.

Introduction

Acute renal failure (renal azotemia) duo to hypovolemia and gastroenteritis is still a common disease, especially among children in developing countries. Mean platelet volume (MPV), which is commonly used as a measure of platelet size, indicates the rate of platelet production and platelet activation. Acute renal failure (ARF) is defined as an abrupt and significant decrease in glomerular filtration rate (GFR) and tubular function. This may lead to decreased excretion of waste products (creatinine, urea, phosphate) and water, resulting in azotemia and altered body fluid homeostasis. Urine output may be low, normal or

high. Early recognition and management are crucial. ARF may be oliguric (<1 mL/kg/hour in neonates and infants, <0.5 mL/kg/hour in children) or nonoliguric. Nonoliguric ARF can be easily missed. Despite normal urine output, electrolyte disturbances and uremia may become significant [1,2]. Urine osmolality is typically similar to serum osmolality in such patients. The major causes of ARF may be divided into prerenal (renal under-perfusion), intrinsic renal (vascular, immunologic, ischemic or toxic kidney injury) and post-renal (urinary tract obstruction or stasis). This classification is useful to apply to the differential diagnosis of oliguric states. If a child has an acute elevation in serum creatinine and no recent oliguria, the likelihood of a prerenal cause for ARF is low. Patients may migrate from one category to another; renal under-perfusion (prerenal) or obstruction (post-renal) for an extended period may result in intrinsic renal damage and ARF. Acute tubular necrosis (ATN) is the most common cause of ARF in children and is usually the consequence of renal under-perfusion. Hypoxia-ischemia resulting from poor perfusion leads to early renal vasoconstriction and eventual tubular injury [3]. Toxic injury secondary to drugs, exogenous toxins (ethylene glycol, methanol) or endogenous toxins (myoglobin, hemoglobin) also result in ATN (Acute Tubular Necrosis). Severe vascular compromise with or without secondary arterial or venous thrombosis may result in acute cortical necrosis. A classification system has been proposed to standardize the definition of acute kidney injury in adults. These criteria of risk, injury, failure, loss and end-stage renal disease were given the acronym of RIFLE as follows;
1) Risk; estimated Clearance Cl (eCCl) decrease by 25% and urine output <0.5 mL/kg/hr for 8 hours
2) Injury; eCCl decrease by 50% and urine output <0.5 mL/kg/hr for 16 hours 3) Failure; eCCl decrease by 75% or eCCl <35 mL/min/1.73 m2 and urine output < 0.3 mL/kg/hr for 24 hours or anuric for 12 hours 4) Loss; Persistent failure > 4 weeks 5) End stage renal disease (persistent failure >3 months) MPV is higher when there is destruction of platelets. This may be seen in inflammatory bowel disease, immune thrombocytopenic purpura (ITP), myeloproliferative diseases and Bernard-Soulier syndrome. It may also be related to pre-eclampsia and recovery from transient hypoplasia. Abnormally low MPV values correlate primarily with thrombocytopenia when it is due to impaired production as aplastic anemia. A typical range of platelet volumes is 9.7–12.8 fL (femtolitre),

equivalent to spheres 2.65 to 2.9 μm in diameter. Normal range is given as 7.5-11.5 fL. We aimed to investigate MPV as a prognostic factor in children with RIFLE criteria of ARF.

Materials and Methods

This was a Case-Control study. The study population consisted of 217 children admitted in amir-kabir hospital with ARF or renal azotemia due to viral gastroenteritis with moderate and severe dehydration. All patients had been followed up for six months. The patients were 59 (risk), 57 (injury), 46 (failure), 43 (loss) and 1(ESRD). Data was recorded in the checklists and analyzed using SPSS20 software (SPSS Inc., Chicago, IL).

Results

Platelet counts were significantly higher and MPV values were significantly lower in patients with criteria of loss and failure during the follow-up compared to controls. Erythrocyte sedimentation rate and C-reactive protein values significantly decreased in patients with ARF after the treatment compared to baseline; whereas, MPV values increased. MPV values were negatively correlated with ESR and WBC and platelet counts. The use of MPV in the evaluation of prognosis in ARF has never been previously evaluated. During the acute stage of ARF with criteria of loss and failure, MPV values were lower compared to other criteria.

Discussion

In our study, MPV was lower in patients with ARF with criteria of loss and failure than those with other criteria of ARF. The mechanism through which the platelets count increases and MPV decreases during ARF has not been evaluated yet. In our study, MPV was lower in criteria loss and failure versus other criteria. Yousefichaijan P. evaluated the role of MPV in reflux nephropathy and found that MPC was higher in patients with reflux nephropathy than non-reflux nephropathy patients and MPV was lower in patients with reflux nephropathy than those without reflux nephropathy [1]. MPV can be used as an indicator in diagnosis of reflux nephropathy in patients with VUR. Song Liu in 2012 reported that MPV decreased in patients with Crohn's disease [5]. In a study by Huseyin Narci in 2013, MPV was higher in patients with acute appendicitis [6]. In a study by Gulsah Gunluoglu in 2014, MPV was lower in

patients with pulmonary tuberculosis than healthy controls [7]. In ocular Behcet's disease, MPV was not a predictive laboratory test to determine clinical improvement following classic immunosuppressive treatment [8]. Akelma AZ evaluated the role of MPV as an inflammatory marker in children with chronic spontaneous urticarial for the first time in 2013 [9]. A decline in MPV may be considered an indicator of inflammation in children with chronic spontaneous urticarial. Ulasli SS evaluated the role of MPV in COPD (Chronic Obstructive Pulmonary Disease) and found that MPV in COPD exacerbation may indicate systemic inflammation. Thus, MPV may be used as a negative acute-phase reactant in COPD exacerbation [10]. Tekin M evaluated the role of MPV in acute pyelonephritis and found that MPV is a fast and reliable measurement with considerable predictive value for the diagnosis of APN and renal scars and its predictive capacity is better than that of CRP, ESR and WBC values [11]. Tanrikulu CS reported that MPV is a routinely measured parameter in complete blood count (CBC) and requires no additional cost. It was significantly decreased in AA, having a greater sensitivity and NPV when combined with WBC and NP [12].

Conclusion

MPV is a fast and reliable measurement with considerable predictive value for prediction of prognosis in acute renal failure. Therefore, we suggest it for diagnosis of acute renal failure.

Acknowledgement

Conflict of Interest

Authors have no conflict of interest to declare.

Financial Support

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