

# Platelet Profile Distribution in Critically Ill Children

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**Abstract:** Thrombocytopenia occurring in a critically ill patient is the result of hemodilution, increased platelet consumption, an immune mechanism (increased platelet destruction), and increased platelet sequestration. Previous studies showed that platelet indices might be a more useful prognostic indicator, but a study on critically ill children is still limited. We report the platelet profile of critically ill children admitted in the pediatric intensive care unit. This report is part of an ongoing study of the prognostic marker in critically ill children that consist of septic and non-septic patients. All patients admitted to the pediatric intensive care unit Haji Adam Malik Hospital and Universitas Sumatera Utara Hospital were recruited. We examined the platelet profile (platelet count, Plateletcrit/PCT, Mean Platelet Volume /MPV and Platelet Distribution Width/PDW) on the first day of admission. Of 53 samples, 29 were boys with an average age of 7.62 (+6.43) years old. Severe malnutrition was found in 12 cases (22.6%). We found platelet count median value was 316000 (23000-828000). Median value of PCT, MPV, and PDW were 0.32 (0.08-1.40), 9.4 (7.9-13.5), 9.7 (7.0-17.5), respectively. As the conclusion of this ongoing study, it is shown that there were changes of platelet profile in critically ill children. Further studies studying its usefulness as a prognostic indicator are still needed.

## 1 INTRODUCTION

Inflammation, regardless of its causes, is very common during critical illness (Kellum et al, 1996). One of the inflammation's hallmarks is endothelial dysfunction, which has an important role in the pathogenesis of organ dysfunction and may be associated with platelet activation and consumption (Aird et al, 2003; Warkentin et al, 2003).

Studies had indicated that inflammation associated endothelial dysfunction is one of the causes of organ failure which is related to platelet activation and consumption. According to these findings, changes in platelet count are closely associated with the prognosis of critically ill patients (Aird et al, 2003; Vanderschueren et al, 2000; Moreau et al, 2007).

Mean platelet volume (MPV) is defined as a ratio of plateletcrit to platelet count and measured in femtolitres. Larger platelets have more rapid respond than smaller platelets, they can release chemical mediators more readily in response either to endogenous or exogenous stimuli (Becchi et al, 2006; Oncel et al, 2012; Gasparyan et al, 2011). The

association between changes of MPV level and patient's morbidity and mortality in various diseases have been reported in several studies (Chu et al, 2010; Cho et al, 2013; Altintoprak et al, 2013; Kandis et al, 2011; Aydemir et al, 2015; Vizioli et al, 2009). However, studies in child population are still limited. Only a few studies that had revealed the association between MPV and early diagnosis (O'Connor et al, 1993; Guida et al, 2003; Akarsu et al, 2005; Oncel et al, 2012; Aksoy et al, 2012; Aydin et al, 2014; Yao et al, 2015; Kim et al, 2015) or mortality (Ahmad et al, 2014; Catal et al, 2014; Zhao et al, 2015) of sepsis. , all of these studies were performed in the neonatal period.

## 2 METHODS

This report is part of an ongoing study of a prognostic marker in critically ill children. In this paper, we describe the platelet profile specifically platelet count, Plateletcrit /PCT, Mean Platelet Volume /MPV and Platelet Distribution

Width/PDW) in critically ill children between Mei – July 2018.

Inclusion criteria were all patients admitted to the pediatric intensive care unit Haji Adam Malik Hospital and Universitas Sumatera Utara Hospital from one month until 18 years old. Patients with malignancy, idiopathic thrombocytopenic purpura, immunodeficiency, history of using chemotherapy agent and refused for laboratory test were excluded. Subjects were taken consecutively. The blood sample was taken on the first day of admission . Data were analyzed using SPSS version 20.

### 3 RESULT

The characteristics of all patients are presented in Table

Table 1: Subjects Characteristics

Characteristic	n = 53
Age (months), mean ± SD	7,6 (± 6,43)
Gender (n, %)	
Boy	29 (54,7)
Girl	24 (45,3)
Nutritional Status (n, %)	
Severe	12 (22,6)
Moderate	7 (13,21)
Normal	33 (62,26)
Overweight	1 (1,89)

n = total number of subject

Table 2 shows the platelet profile’s values. We found that platelet count have a wide range. The minimum level was 23000/  $\mu$ L (thrombocytopenia), and the maximum level was 828000/  $\mu$ L (thrombocytosis). We also found the minimum and maximum level of PCT were out of

normal range. The maximum level of MPV was higher than the average value. The minimum level of PDW was lower than average value.

Table 2: Platelet Profile

Platelet profile	n = 53	Normal value (population mean)
Platelet count (/ $\mu$ L), median (min-max)	316000 (23000–828000)	150000-450000
PCT (%), median (min-max)	0,3 (0,08–1,4)	(0,1-0,5)
MPV (fl), median (min-max)	9,4 (7,9–13,5)	(6,5-9,5)
PDW (%), median (min-max)	9,7 (7,0–17,5)	(10-18)

### 4 DISCUSSION

Our study found that platelet profile in critically ill children on day one of admission had abnormal value. In this study, we found subjects with thrombocytopenia (<15000/  $\mu$ L) and also thrombocytosis (>450000/ $\mu$ L). Thrombocytopenia was found on day one of admission , and it might be because of varies underlying disease in critically ill children.

Thrombocytopenia is one of the most frequent laboratory abnormalities encountered in ICU, and the reported incidence varies from 13 to 58% in various studies (Strauss et al, 2002; Crowther et al, 2005; Aissaoui et al, 2007; Guida et al, 2003). Various conditions have been identified as underlying cause of thrombocytopenia, such as disseminated intravascular coagulation, immune mechanisms, reduced production, increased consumption or irregular sequestration of platelets or a combination of these (Bogdonof et al, 1990; Housinger et al, 1993). PCT reflects not only the platelet count but also platelet size. In this study, we found that minimum and maximum level of PCT

were out of laboratory normal range that reflect the platelet count level.

MPV level was increased in this study. Mean platelet volume (MPV) is one of the platelet indices which is frequently used and routinely measured in the complete blood count test with automatic analyzer. MPV is defined as a ratio of plateletcrit to platelet count and is measured in femtoliters (Zhang et al, 2014). Van Der Leile et al have shown an increase in MPV in septicemic patients (Van der liele et al, 1983), he postulated that with sepsis there is increased thrombocytosis and this result in increased megakaryocyte ploidy and an increase in MPV.

PDW level in this study decreased. This result was contradict with Patrick et al who studied PDW level in neonates with late onset sepsis. He found that PDW increased in sepsis (Patrick et al, 1990). Based on this result, our ongoing study will investigate the role of the platelet profile as prognostic factors in critically ill children.

## 5 CONCLUSIONS

There were changes in platelet profile distribution in critically ill children. Further studies studying its usefulness as a prognostic indicator are still needed.

## REFERENCES

- Ahmad, MS, Waheed, A., 2014. Platelet counts, MPV and PDW in culture proven and probable neonatal sepsis and association of platelet counts with mortality rate. *J Coll Physicians Surg Pak*. 24: 340-4.
- Aird, WC., 2003. The role of the endothelium in severe sepsis and multiple organ dysfunction syndrome. *Blood*. 101(10):3765-3777.
- Aissaoui, Y, Benkabbou, A, Alilou, M, Moussaoui, R, El, Hijri, A, Abouqal, R., 2007. Thrombocytopenia in a surgical intensive care unit, incidence, risk factors and effects on outcome. *Presse Med*. 36:43-9.
- Akarsu, S, Taskin, E, Kilic, M., 2005. The effects of different infectious organisms on platelet counts and platelet indices in neonates with sepsis: is there an organism-specific response? *J Trop Pediatr*. 51:388-91.
- Aksoy, HT, Eras, Z, Guzoglu, N, Canpolat, FE, Dilmen, U., 2013. Mean platelet volume is not associated with bacterial sepsis in newborns. *Int J Infect Dis*. 17: e1263.
- Altintoprak, F, Arslan, Y, Yalkin, O, Uzunoglu, Y, Ozkan, OV., 2013. Mean platelet volume as a potential prognostic marker in patients with acute mesenteric ischemia-retrospective study. *World J Emerg Surg*. 8: 49.
- Aydemir, H, Piskin, N, Akduman, D, Kokturk, F, Aktas, E., 2015. Platelet and mean platelet volume kinetics in adult patients with sepsis. *Platelets*. 26: 331-335.
- Aydın, B, Dilli, D, Zenciroğlu, A, Karadağ, N, Beken, S, Okumuş, N., 2014. Mean platelet volume and uric acid levels in neonatal sepsis. *Indian J Pediatr*. 81: 1342-6.
- Becchi, C, Al, Malyan, M, Fabbri, LP, Marsili, M, Boddi, V, Boncinelli, S., 2006. Mean platelet volume trend in sepsis: is it a useful parameter? *Minerva Anestesiol*. 72(9):749-56.
- Bogdonoff, D, Williams, M, Stone, D., 1990. Thrombocytopenia in critically ill patient. *J Crit Care*. 3:186-205.
- Catal, F, Tayman, C, Tonbul, A., 2014. Mean platelet volume (MPV) may simply predict the severity of sepsis in preterm infants. *Clin Lab*. 60: 1193-1200.
- Chu, SG, Becker, RC, Berger, PB., 2010. Mean platelet volume as a predictor of cardiovascular risk: a systematic review and meta-analysis. *J Thromb Haemost*. 8:148-56.
- Cho, SY, Jeon, YL, Choi, SK, Suh, JT, Lee, HJ, Park, TS., 2013. Mean platelet volume in Korean patients with acute ischemic stroke: a gender difference. *Platelets*. 24:75-6.
- Crowther, MA, Cook, DJ, Meade, MO, Griffith, LE, Guyatt, GH, Arnold, DM., 2005. Thrombocytopenia in a medical-surgical critically ill patients: Prevalence, incidence and risk factors. *J Crit Care*. 20:348-53.
- Gasparyan, AY, Ayvazyan, L, Mikhailidis, DP, Kitas, GD., 2011. Mean platelet volume: a link between thrombosis and inflammation? *Curr Pharm Des*. 17(1):47-58.
- Guida, JD, Kunig, AM, Leef, KH, McKenzie, SE, Paul, DA., 2003. Platelet count and sepsis in very low birth weight neonates: is there an organism-specific response? *Pediatrics*. 111: 1411-5.
- Housinger, T, Brinkerhoff, C, Warden, G., 1993. The relationship between platelet count, sepsis and survival in pediatric burn patients. *Arch Surg*. 128:65-7.
- Kandis, H, Ozhan, H, Ordu, S., 2011. The prognostic value of mean platelet volume in decompensated heart failure. *Emerg Med J*. 28: 575-578.
- Kellum, JA, Decker, JM., 1996. The immune system: relation to sepsis and multiple organ failure. *AACN Clin Issues*. 7(3):339-50. quiz 459-360.
- Kim, JY, Yoon, J, Lim, CS, Choi, BM, Yoon, SY., 2015. Clinical significance of platelet-associated hematological parameters as an early supplementary diagnostic tool for sepsis in thrombocytopenic very-low-birth-weight infants. *Platelets*. 26: 620-6.
- Moreau, D, Timsit, JF, Vesin, A., 2007. Platelet count decline: an early prognostic marker in critically ill patients with prolonged ICU stays. *Chest*. 131: 1735-41.
- O'Connor, TA, Ringer, KM, Gaddis, ML., 1993. Mean platelet volume during coagulase-negative staphylococcal sepsis in neonates. *Am J Clin Pathol*.

- Oncel, MY, Ozdemir, R, Yurttutan, S., 2012. Mean platelet volume in neonatal sepsis. *J Clin Lab Anal.* 26(6): 493-6.
- Patrick, CH, Lazarchick, J. The effect of bacteremia on automated platelet measurements in neonates. *Am. J. Clin. Pathol.* 93(3):391-4.
- Strauss, R, Wehler, M, Mehler, K, Kreitzer, D, Koebnick, C, Hahn, E., 2002. Thrombocytopenia in patients in the Medical Intensive Care Unit: Bleeding prevalence, transfusion requirement and outcome. *Crit Care Med.* 30:1765-71.
- Van, der, Lelie, J, Von, dem, Borne, AK., 1983. Increased mean platelet volume in septicaemia. *J. Clin. Pathol.* 36(6):693-6.
- Vanderschueren, S, De, Weerd, A, Malbrain, M., 2000. Thrombocytopenia and prognosis in intensive care. *Crit Care Med.* 28: 1871-6.
- Vizioli, L, Muscari, S, Muscari, A., 2009. The relationship of mean platelet volume with the risk and prognosis of cardiovascular diseases. *Int J Clin Pract.* 63: 1509-15.
- Warkentin, TE, Aird, WC, Rand, JH., 2003. Platelet-endothelial interactions: sepsis, HIT, and antiphospholipid syndrome. *Hematology Am Soc Hematol Educ Program.* 2003(1):497-519.
- Yao, Y, Tu, Y, Lu, Q., 2015. Values of C-reactive protein, percentage of neutrophils and mean platelet volume in early diagnosis of neonatal sepsis. *Zhongguo Dang Dai Er Ke Za Zhi.* 17: 425-9.
- Zhang, Z, Xu, X, Ni, H, Deng, H., 2014. Platelet indices are novel predictors of hospital mortality in intensive care unit patients. *J Crit Care.* 29: 885.e1-6.
- Zhao, D, Qiu, G, Luo, Z, Zhang, Y., 2015. Platelet parameters and (1,3)- $\beta$ -D-glucan as a diagnostic and prognostic marker of invasive fungal disease in preterm infants. *PLoS One.* 10: e0123907.