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Platelet Profile as Prognostic Factor in Critically ill Children

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Abstract

BACKGROUND: Previous studies showed that platelet profile may reflect the platelet function better than the platelet count itself, but the study on its use as a prognostic indicator in critically ill children is still limited.

AIM: We analyzed the association between platelet profile such as platelet count, plateletcrit (PCT), mean platelet volume (MPV), and platelet distribution width (PDW) and mortality, also its correlation with pediatric logistic organ dysfunction-2 (PELOD-2) score in critically ill children admitted to the pediatric intensive care unit (PICU).

METHODS: A prospective cohort study was conducted in PICU Haji Adam Malik General Hospital, Medan. Assessment of platelet profile (platelet count, PCT, MPV, and PDW) and PELOD score on the 1st and 3rd day of PICU admission were performed.

RESULTS: Eighty-three subjects were recruited in this study, 44 were boy with a median age of 6 (1–17) years old. The septic patient was 43 subjects (51.8%). Platelet count on the 1st day ($p = 0.024$) and PDW on the 3rd day ($p = 0.018$) of PICU admission was significantly associated with mortality. There was no correlation between platelet profile and PELOD-2 score on day 1 and 3. However, the difference between MPV on days 1 and 3 (ΔMPV) significantly correlated with the change of PELOD-2 score ($r = 0,647$, $p < 0.0001$).

CONCLUSION: Platelet count on 1st day and PDW on the 3rd day had a significant association with mortality but no correlation between platelet profile and PELOD-2 score.

Introduction

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 [1]. The platelet profile may reflect the platelet function better than the platelet count itself [2]. The platelet profile includes mean platelet volume (MPV), platelet distribution width (platelet distribution width [PDW]), and plateletcrit (PCT). They are part of routine hematologic parameters examined in routine complete blood count; thus, it is low cost and very feasible in daily clinical practice; however, their use and application in critically ill children are still limited [3].

The association between changes in MPV level and patient's morbidity and mortality in various diseases has been reported in several adult studies [4], [5], [6], [7]. However, studies in children population are still limited. Only a few studies had revealed the association between MPV and early diagnosis [8], [9], [10], [11] or mortality of sepsis in the neonatal period [12], [13]. We used pediatric logistic organ dysfunction-2 (PELOD-2) score and mortality as prognostic in this study.

Methods

This prospective cohort study on critically ill children was conducted between May 2018 and July 2018. Inclusion criteria were children aged 1 month–18 years old, admitted to the pediatric intensive care unit (PICU) Haji Adam Malik Hospital and Universitas Sumatera Utara Hospital.

Patients with malignancy, idiopathic thrombocytopenic purpura, immunodeficiency, history of using chemotherapy agent, and refused for laboratory test were excluded from the study. Subjects were recruited consecutively.

We examined the platelet profile (platelet count, PCT, MPV, and PDW) and PELOD-2 score on the 1st and 3rd day of PICU admission. Data were analyzed using SPSS version 20. This study was approved by the Health Research Ethical Committee, Medical Faculty, Universitas Sumatera Utara with No.206/TGL/KEPK FK USU-RSUP HAM/2018.

Results

From this study, of all 83 patients recruited, sepsis was found in 43 subjects. Mortality was found in

19 (25%) patients. The baseline characteristics of study subjects are shown in Table 1.

Table 1: Subject characteristics

Characteristic	n=83
Age (months); median (min-max)	6 (1–17)
Gender; n (%)	
Boys	44 (53)
Girls	39 (47)
Nutritional status; n (%)	
Severe malnutrition	20 (23.8)
Moderate malnutrition	11 (13.1)
Normal	51 (61.4)
Overweight	1 (1.2)
Mortality; n (%)	19 (25)
Sepsis	43 (51.8)
Platelet count/mm^3, mean (SD)	327,200 (169,931)
MPV, pg; median (min-max)	9.2 (7.9–1.6)
PCT, pg; median (min-max)	0.32 (0.07–1.4)
PDW, pg; median (min-max)	9.7 (7–15.7)
PELOD-2 score; median (min-max)	3.5 (0–19)

PELOD-2: Pediatric logistic organ dysfunction-2, PWD: Platelet distribution width, PCT: Plateletcrit, MPV: Mean platelet volume.

Table 2 shows the association between each platelet profile and mortality. Abnormal platelet counts on the 1st day of PICU admission were significantly associated with mortality (p = 0.024). We also found a statistically significant association between PDW on the 3rd day of PICU admission and mortality (0.018). Neither MPV nor PCT showed any statistically significant association with mortality in this study.

Table 2: Association between each platelet indices and mortality on 1st and 3rd days of PICU admission

Platelet Indices	Mortality (n%)	Survival (n%)	P
Day 1			
Platelet, mm^3			
Normal	8	46	0.024
Abnormal	11	18	
MPV			
Normal	10	28	0.237
Abnormal	6	33	
PCT			
Normal	11	49	0.297
Abnormal	3	6	
PDW			
Normal	6	28	0.512
Abnormal	10	32	
Day 3			
Platelet, mm^3			
Normal	7	31	0.921
Abnormal	6	25	
MPV			
Normal	4	25	0.412
Abnormal	7	25	
PCT			
Normal	9	40	0.929
Abnormal	1	4	
PDW			
Normal	10	26	0.018
Abnormal	1	24	

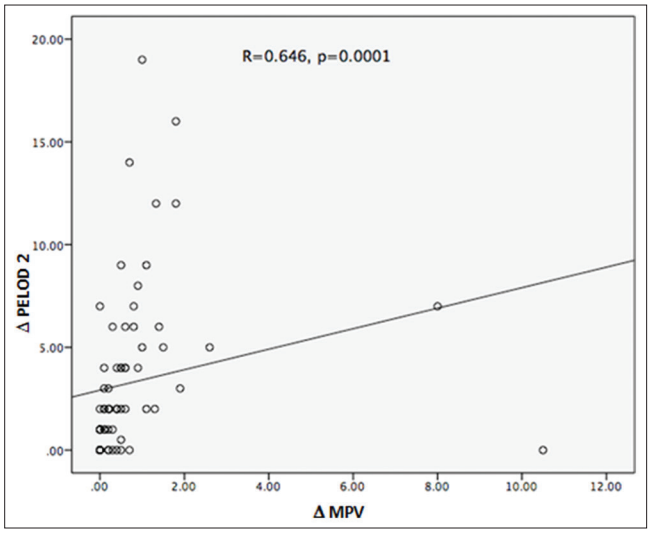
PELOD-2: Pediatric logistic organ dysfunction-2, PWD: Platelet distribution width, PCT: Plateletcrit, MPV: Mean platelet volume, PICU: Pediatric intensive care unit.

Table 3 shows that there was no correlation between MPV, PDW, PCT, and Platelet with PELOD-2 score. However, it turns out that the difference of MPV (Δ MPV) and PELOD-2 score (Δ PELOD-2) at the 1st and 3rd day has a significant correlation as describe on Graphic 1 (r = 0.646, p < 0.0001).

Table 3: Correlation between platelet profile and PELOD-2 score

Platelet profile	PELOD-2 score D1		Platelet profile	PELOD-2 score D3	
	R	p		R	p
MPV	0.183	0.258	MPV	−0.027	0.878
PDW	0.031	0.848	PDW	−0.023	0.899
PCT	−0.129	0.445	PCT	−0.177	0.340
Platelet	−0.332	0.03	Platelet	−0.238	0.151

PELOD-2: Pediatric logistic organ dysfunction-2, PWD: Platelet distribution width, PCT: Plateletcrit, MPV: Mean platelet volume.



Graphic 1: Correlation between Δ mean platelet volume and Δ pediatric logistic organ dysfunction-2

Discussion

There is growing evidence to show that MPV, PDW, and red blood cell distribution width are associated with mortality in adult population. Gao *et al*. show that PDW has increasing trends, while PCT and platelet count decreased in the non-survivor group and compared with other more usual septic shock prognostic markers, MPV is also second only to lactate for the highest area under the curve. Tajarernmuang *et al.* also stated that MPV was observed to be significantly higher in non-survivor groups after the 3rd day of admission [2], [3]. In this study, we found a statistically significant association between platelet on 1st day and PDW on the 3rd day of PICU admission and mortality, while neither MPV nor PCT showed any statistically significant association with mortality in this study. Mean platelet count is almost entirely normal in the survival group on 1st day and then becomes abnormal on day 3, its likely due to the different course of the disease and different degrees of inflammation.

Studies on clinical values of platelet profile in critically ill children are still limited. A retrospective study by Ye *et al.* on critically ill children receiving mechanical ventilation reported that there were significant associations between PCT and PDW with mortality. These studies also demonstrated that patients with a low platelet count and high MPV and PDW survived for a shorter time than those with normal platelet indices; thus, platelet indices were proposed as a novel prognostic indicator in critically ill patients [14]. Similarly, Aydemir *et al*. show that increase in MPV values was statistically significant for the first 3 days of sepsis [7]. A systematic review and meta-analyses by Tajarernmuang *et al*. also show that initial values of MPV might not be used as

a prognostic marker of mortality in critically ill patients, while subsequent values of MPV after the 3rd day might be useful [2]. This study is consistent with our result that shows a significant correlation between the difference of MPV (Δ MPV) and PELOD-2 score (Δ PELOD-2).

The course of an inflammatory condition is also associated with an increased percentage of large platelets, probably due to intracellular synthesis of procoagulatory and proinflammatory factors, degranulation of granules, and initiation of the platelet pool stored in the spleen [15]. Simultaneously, these cells rapidly migrate to the site of inflammation, where they undergo activation and use [16]. This seems to explain the drop in MPV in patients with ongoing inflammation [17].

In the clinical setting, platelet profile and PELOD-2 score should be examined serially on the 1st day as basic data and followed by the 3rd day, so we can assess the prognostic of the critically ill patient. This suggested that serial measurements had more valuable predictive value than examination on admission only.

Conclusion

We found that platelet on 1st day and PDW on the 3rd day of PICU admission had a significant association with mortality. There was no correlation between platelet profile and PELOD-2 score, but the difference of MPV (ΔMPV) and PELOD-2 score (Δ PELOD-2) between the examinations has a significant correlation. Subsequent values of the platelet profile might had more valuable predictive value than one initial examination. Further studies analyzing its usefulness in critically ill children are still needed.

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