



Platelet Distribution Width to Platelet Count Ratio as a Predictor of Mortality in Children Admitted In PICU

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Abstract

Background: Several studies have confirmed dynamic nature of platelet in critically ill children. Among critically ill children, platelet count decreases during the initial four days of the illness both in survivors and in no survivors and reaches a nadir on day four. This initial decline in platelet count is later followed by an increment. The decline in platelet count or failure of the rise in platelet count can be used as a prognostic marker for determining outcome among critically ill children.

Methods: All the patients who were admitted to PICU during the study period were assessed for the eligibility, those who satisfied the inclusion criteria were included in our study. After getting written consent from guardians on the very first day of their admission, 2ml of venous blood was collected in EDTA vacutainers under aseptic precautions and it was sent to laboratory as early as possible.

Results: The sensitivity (82.57%) and NPV (77.91%) was highest for MPV, followed by plateletcrit (76.15%, 78.33%), and platelet count(70.64%,76.3%). The specificity (92.77%) and PPV(77.35%) was highest for PDW/PLC ratio. The diagnostic accuracy of PDW/PLC was 70.91% which was highest compared to all other platelet indices.

Conclusion: It can be included with other platelet indices such as PCT, PLC, and MPV having good sensitivity in a composite scoring systems to predict mortality.

Keywords: PCT, MPV, PLC.

Introduction

Platelets, a major and essential constituent of blood plays an important role in physiological and pathological processes such as coagulation, thrombosis, inflammation and maintenance of the integrity of vascular endothelial cells.^{1,2} Platelet indices are a group of parameters that are easy to measure, cost effective

and give clue to aetiology of thrombocytopenia and platelet morphology.³ The commonly used platelet indices include platelet count (PLC), Mean platelet volume (MPV), Platelet distribution width (PDW) and Plateletcrit (PCT). The Mean platelet volume (MPV) refers to ratio of PCT/PLC, PDW is numerically equal to co-efficient of platelet volume variation which is used to describe the dispersion of platelet volume, and plateletcrit refers to product of platelet count and mean platelet volume.⁴

The bleeding manifestation was initially thought to be directly related to the severity of thrombocytopenia. However, a study by Greinacher A et al, observed that bleeding is not only depended on platelet count but also on other additional factors like underlying pathology, disease process, vascular status, platelet function, anticoagulant medication and other plasma factor involved in coagulation.⁵ According to the studies done previously, single platelet count done at admission has lesser prognostic importance than a change of platelet count over time for predicting the outcome among critically ill children.⁶

Several studies have confirmed dynamic nature of platelet in critically ill children. Among critically ill children, platelet count decreases during the initial four days of the illness both in survivors and in no survivors and reaches a nadir on day four. This initial decline in platelet count is later followed by an increment.^{7,8} The decline in platelet count or failure of the rise in platelet count can be used as a prognostic marker for determining outcome among critically ill children.^{9,10}

Materials and Methods

PLACE OF STUDY: The study was conducted in the department of Pediatric medicine, Sir Padampat mother and child health institute (SPMCHI) and Advanced hematology laboratory, SMS medical college, Jaipur.

Study Period: From October 2018 to April 2019.

Study Design: Observational prospective study.

Subjects: All the patients who were admitted in PICU of SPMCHI hospital, SMS medical college consecutively in the above said time period were taken as subjects in this study, after screening for inclusion and exclusion criteria. Later on subjects were divided into two groups spontaneously based on their outcome of PICU stay.

Sample Size: Sample size was calculated at 95 % confidence level and alpha error of 0.05 Assuming 77.14 % mortality among the pediatric patients with PDW/PLC above the cut-off level of 0.07 as per the reference article. At 5% absolute allowable error in the mortality of hospital admitted patients, the required sample size was 283 PICU admitted patients.

Inclusion and Exclusion Criteria

Inclusion Criteria: The patients who were admitted in PICU consecutively aged >1year and <18 year.

Exclusion Criteria

- Patients whose outcome was not known
- Those who left against medical advice
- Patients requiring immediate surgery
- Patients who were having hereditary or other platelet disorders
- Patients who had taken drugs which were known to cause thrombocytopenia.
- Those who refused to give consent

Methodology

All the patients who were admitted to PICU during the study period were assessed for the eligibility, those who satisfied the inclusion criteria were included in our study. After getting written consent from guardians on the very first day of their admission, 2ml of venous blood was collected in EDTA vacutainers under aseptic precautions and it was sent to laboratory as early as

possible. The samples were run in automated hematology analyzer SYSMEX XN-1000 in this platelets were measured by sheath flow direct current method and the values of platelet indices such as PLC, PDW, PCT, MPV were noted. Patients were followed until discharged or death and were classified according to the outcome as controls (survivors) and cases(non-survivors) respectively.

Statistical Analysis: Continuous data was summarized in the form of mean and standard deviation. Categorical data was expressed in form of proportions. Difference in the proportion was analyzed using Chi Square test. Difference in mean was analyzed using unpaired t test. The level of significance was kept at 95% for all statistical analysis, p value <0.05 was taken as significant.

Results

Table 1: Distribution of study subjects according to their outcome

Outcome	N	Percentage
Discharged (Survivor)	166	58.6%
Death (Non- Survivor)	109	38.5%
LAMA	7	2.5%
Surgery	1	0.35%
Total	283	100

Total 285 patients were enrolled in the study out of them 7 (2.5%) patients went LAMA and 1 (0.35%) patient was shifted for surgery. Remaining 275 patients were included in the study, out of them 166 (60.3%) survived who acted as controls and 109 (39.7%) patients died who acted as cases.

Table 2: Distribution of study subjects according to age

Age group (years)	Survivors		Non -Survivors		Total	
	N	%	N	%	N	%
1-5 years	64	38.6	39	35.8	103	37.5
5-10 years	56	33.7	34	31.2	90	32.7
10-15 years	40	24.1	26	23.9	66	24

16-18 years	6	3.6	10	9.1	16	5.8
Total	166	100	109	100	275	100

Chi-square = 3.763 with 3 degrees of freedom P = 0.388 (NS)

Majority of subjects belonged to the age group of 1-5 years(37.5%) followed by the age group of 5-10 years (32.7%), followed by the age group of 10-15 years (24%). Out of total 109 patients who died, age group of 1-5 years accounted for 35.8% of total deaths, 5-10 year age group accounted for 31.2% of total deaths, 10-15 year age group accounted for 23.9% of total deaths, 15-18 year age group accounted for 9.1% of total death. The difference was statistically not significant (p=0.388).

Table 3: Distribution of study subjects according to gender

Outcome	Males		Females		Total N
	N	%	N	%	
Survivors	98	59.8	68	61.3	166
Non-survivors	66	40.2	43	38.7	109
Total	164	100	111	100	275

Chi-square = 0.016 with 1 degree of freedom P = 0.901 (NS)

In our study male patients were 164 (59.6%), out of them 66 (40.2%) patients died, whereas female patients were 111(39.4%), out of them 43 (38.7%) patients died. The difference was not statistically significant (p=0.901).

Table 4: Platelet indices in relation to outcome

Platelet indices	Survivors (mean±SD)	Non- Survivors (Mean±SD)	P value
Platelet count (10 ³ /μl)	247.2 ± 156.2	150.8 ± 111.4	<0.001 (S)
PCT (%)	0.3 ± 0.2	0.2 ± 0.1	<0.001 (S)
MPV (fl)	11.4 ± 1.9	11.9 ± 1.7	0.019 (S)
PDW (%)	14.2 ± 3.8	15.6 ± 4	0.005 (S)
PDW / PLC	0.1 ± 0.1	0.2 ± 0.2	<0.001(S)

The mean platelet count among survivors was 247.2±156.2 and among non-survivors it was

150.8±111.4 (p<0.001). The mean plateletcrit among survivors was 0.3±0.2 and among non- survivors it was 0.2±0.1 (p <0.001). The mean MPV among survivors was 11.4±1.9 and among non- survivors it was 11.9±1.7 (p=0.019). The mean PDW among survivors was 14.2 ±3.8 and among non-survivors it was 15.6±4 (p=0.005). The mean value of PDW/PLC ratio among survivors was 0.1±0.1 and among non- survivors it was 0.2±0.2 (p<0.001). The p value was significant for all the platelet indices between survivors and non-survivors.

Table 5: ROC curve for Platelet indices for predicting mortality

Platelet indices	AUC	Critical cut off point	P value
Platelet count (10 ³ /μl)	0.700	< 174 x 10 ³	<0.001(S)
PCT (%)	0.709	< 0.25	<0.001(S)
MPV (fl)	0.594	> 10.75	0.008 (S)
PDW (Fl)	0.601	> 12.4	0.004 (S)
PDW / PLC	0.687	> 0.195	<0.001 (S)

The critical cut off point for platelet count was <174 ×10 /μL and the AUC in ROC was 0.700. Cut off point for plateletcrit was <0.25% and AUC was 0.709, cut off point for MPV was >10.75fL and AUC was 0.594, cut off value for PDW was >12.4 and AUC was 0.601 and cut off point for PDW/PLC ratio was >0.195 and AUC was 0.687. The p value was significant for the cut off values of all the platelet indices.

Table 6: Statistical parameters of platelet indices for predicting mortality

Statistical parameter	PLC	PCT	MPV	PDW	PDW/PLC
Sensitivity	70.64%	76.15%	82.57%	77.98%	37.14%
Specificity	62.05%	56.63%	40.36%	42.17%	92.77%
PPV	55%	53.55%	47.62%	46.96%	77.36%
NPV	76.3%	78.33%	77.91%	74.47%	69.37%
Diagnostic accuracy	65.45%	64.36%	57.09%	56.36%	70.91%

The sensitivity (82.57%) and NPV (77.91%) was highest for MPV, followed by plateletcrit (76.15%,

78.33%), and platelet count(70.64%,76.3%). The specificity (92.77%) and PPV(77.35%) was highest for PDW/PLC ratio. The diagnostic accuracy of PDW/PLC was 70.91% which was highest compared to all other platelet indices.

Discussion

Originally, platelet indices have been applied in the diagnosis of hematological system diseases. Recently, it has been discovered that these indices are related to the severity of illness and patient’s prognosis. PDW/PLC ratio had been found to be an effective predictor of mortality by researchers, hence we conducted this study to validate the findings of previous studies. The present study was a hospital based prospective observational study done in paediatric intensive care unit, department of paediatrics, SMS medical college, Jaipur. Conducted between October 2018 to April 2019. A total of 283 patients were enrolled and after applying exclusion criteria total 275 patients remained in the study, out of them 166 patients survived who acted as controls and 109 patients died who acted as cases

We found that if the counts are < 174000 per mm³ the chances of mortality was high(p<0.001) with sensitivity and specificity of 70.64% and 62.05% respectively and AUC for ROC was 0.700 with diagnostic accuracy of 65.45%. The sensitivity and AUC for ROC values are consistent with the values found by Pragati purbiya et.al¹¹ who found sensitivity 77.1%, and AUC for ROC as 0.799, but our values of specificity was inconsistent with values of Pragati purbiya et.al¹¹ who found higher specificity of 75.8% because they may used different hematology analyser or because of difference in time lapsed between collection and processing of sample. In our study cut off value for platelets was 174000 per mm³ which was more than what shenzhang et .al¹² found whose cut-off was

100000mm³ with sensitivity and specificity of 60.1% and 91.2% and less than what pragati purbiya et.al found with 246000 per mm³. The mean platelet count among survivors was 247.2±156.2 ×10³ per mm³ which was consistent with the results of Guclu et.al¹³ and Kucukardali et.al¹⁴ where as among non-survivors it was 150.8±111.4×10³ mm³ which was consistent with results of S. zheng et.al¹²

Study	Mean platelet count ×10 ³ µL		Cut off	sensi vity	specifi city	AU C	O R
	survivor s	died					
Golwala et al 2016 ¹⁵	312.4±164.5	217.4±165.9	<245	67%	65%	0.66	3.86
s.zheng et al 2015 ¹²	196.5±103.3	141.1±48.3	<169	60.1%	91.2%	0.78	1.96
Purbiya et al 2017 ¹⁶	346±164	175.8±161.5	<246	77.1%	75.8%	0.79	
Guclu et al 2013 ¹³	242.2±145.2	201.4±102.7					
Kucukardali et al ¹⁴	244±118.2	204.8±116.9					
Present study	247.2±156.2	150.8±111.4	<174	70.64%	62.05%	0.700	

Conclusion

It can be included with other platelet indices such as PCT, PLC, and MPV having good sensitivity in a composite scoring systems to predict mortality.

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