International Journal of Contemporary Pediatrics
Rani VV et al. Int J Contemp Pediatr. 2021 Mar;8(3):522-527
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291

DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20210658

Original Research Article

Study of platelet parameters in sick children

Varada Vidya Rani, Ravichander Balasundaram*

Department of Pediatrics, MVJ Medical College and Research Hospital, Dandupalya, Hoskote, Bangalore, Karnataka, India

Received: 08 January 2021
Revised: 11 February 2021
Accepted: 12 February 2021

***Correspondence:**
Dr. Ravichander Balasundaram,
E-mail: ravi4110@yahoo.com

ABSTRACT

Background: Prediction of outcome of a patient plays a key role in the management of PICU. Studies have predicted that platelet parameters are novel predictors of mortality. Hence, present study was designed to assess the accuracy of platelet parameters (platelet count, MPV (mean platelet volume), PDW (platelet distribution width), PCT (Plateletcrit), MPV/PCT, PDW/Platelet count, MPV/platelet count in prediction of mortality and morbidity.
Methods: Total 66 children requiring admission to PICU, were divided as sick (with sick score≥3) and non-sick (with sick score<3). Their platelet parameters were compared. Platelet parameters were further studied with respect to morbidity and mortality. Statistical analysis was done using SPSS 22 version software. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and standard deviation. Independent t test was used as test of significance to identify the mean difference between two quantitative variables.
Results: Both groups were comparable in terms of age and gender. Significant difference in all platelet parameters were noted in between groups ($p<0.001$). Platelet parameters and their ratios were significant predictors of mortality and morbidity, with negative correlation to platelet count and plateletcrit (PCT), and positive correlation to the rest.
Conclusions: Simple analysis of platelet indices at admission by haematology counter analysers could give us a great idea in predicting the mortality and morbidity of the children.

Keywords: Sick children, Platelet indices

INTRODUCTION

Since the early 1980s, evaluation in ICUs has been directed towards new technologies, new therapeutic strategies, evaluation of activities and services, cost analysis, and clinical decision making. The most important goal of ICU activity is to decrease mortality. Identification of patients with a high risk of mortality in ICUs is generally based on the use of scoring systems or mortality predictors. Patients are classified according to prognostic factors defined by clinical experts or by specific statistical analysis.[1] This predictive approach is supposed to improve the choice of diagnostic tests and treatments, and to enable decisions to be made in accordance with the expected severity of the critically ill patient.[2,3]

Estimation of the expected evolution of patients admitted to ICUs is also possible, although individual prediction remains controversial, as there will be patients for whom power of science is limited and for whom further treatment cannot change the outcome.[4,5] Finally, it allows clinical trials to be planned using prognostic factors as criteria for inclusion, stratification or adjustment, and is thus of major interest for multi-centre studies with patient recruitment varying from one ICU to another.[1]

In-hospital mortality depends on the severity of the illness at the time of admission. Severities of illness scores have been developed to predict the mortality in the intensive care unit (ICU).[6] Scoring systems such as the PSI (physiologic stability index), PRISM score (paediatric risk of mortality), SICK score (signs of inflammation that can kill) are severity of illness scores used in children.[6-8] They were used to stratify children based on a lot of clinical and lab parameters. SICK score uses only clinical parameters, and no lab parameters and also a good predictor of sickness in ICU admissions.[8]

The SICK score can be determined immediately on presentation to the emergency department. This allows the score to be used to prioritize care in more seriously ill patients. It uses the physical signs of SIRS (Systemic Inflammatory Response Syndrome) and MODS (Multiple Organ Dysfunction Syndrome).

SICK score could be tested and found useful even in the emergency department to prioritize care and identify patients who would benefit from transfer urgently to an ICU. It is also hoped that this clinical score may inform decisions about admission to the ICU or routine ward care. Hence, SICK score is highly reliable for triaging, admission guidance as well as prognostic prediction. Table Number 1 enlists the parameters evaluated in SICK score and their abnormal ranges.

Table 1: Parameters evaluated in SICK score and their abnormal ranges.

Variable	Abnormal range
Temperature	>38ºC
	<36ºC
Heart rate	Infant >160 per minute
	Child >150 per minute
Respiratory rate	Infant >60 per minute
	Child >50 per minute
Systolic blood pressure	Infant <65 mm Hg
	Child <75 mm Hg
SpO_2	<90%
Capillary refill time	≥3 seconds
AVPU Scale	Anyone except A
An alert	
V responds to voice	
P Responds to pain	
U unresponsive	

The SICK score uses only physical criteria without needing recourse to laboratory results. This has cost implications and also makes it immediately determinable on presentation. Furthermore, no special training is needed for its implementation.[9] The SICK score was considered excellent at predicting mortality. With increasing scores, increasing mortality is present.[10] Sick score is as good a predictor of mortality as PRISM score, which includes even lab parameters.[11] However, on recent evaluations, platelets and their parameters are novel predictors of mortality.

Platelet parameters like Platelet count, mean platelet volume, platelet distribution width and plateletcrit reflected mortality in majority of the studies. Platelets play a major role in antimicrobial host defense, the induction of inflammation and tissue repair.[12] Activation of platelets by agonists enhances platelet interactions with complement proteins and humoral immune components, as well as leukocytes and endothelial cells. They are capable of binding, aggregating and internalizing microorganisms, which enhances the clearance of pathogens from bloodstream and also participate in antibody dependent cell cytotoxicity functions to kill protozoal pathogens by releasing array of potent antimicrobial peptides.

Vanderschueren and colleagues showed that thrombocytopenia by itself effectively predicts mortality in adults.[13] Septicemia related platelet destruction causes increased production of larger and/or younger platelets, and in order to obtain a larger surface, platelets change their discoid shape to a spherical shape, pseudopodia formation occurs. Platelets with increased number and size of pseudopodia increases the MPV and PDW.[14] Plateletcrit is the total volume occupied by platelets in the blood. And it is maintained in equilibrium by regeneration and elimination. Hence, this parameter is usually maintained by changes in platelet counts and the mean platelet volume.

A simple component of the blood, platelet parameters could help us analyse mortality and morbidity in ICU. Platelet parameters, are easily available by counter analysers, along with complete blood count which is one of the most important initial investigation in any patient admitted. With the ease of availability of platelet parameters and their significant role in prediction of mortality, there are only limited number of studies undertaken in this field. Hence, this study was undertaken to study the association of Platelet parameters in prediction of mortality and morbidity.

METHODS

The study was done in the Intensive Care Unit of MVJ Medical Research Hospital, a tertiary care rural hospital for a period of 2 years between August 2018 and August 2020. All children admitted in PICU in the age group 2years to 10years, were assessed for clinical manifestations, vital parameters. Children with sick score≥3 were included in the study and those with sick score<3 were taken as controls. Children with pre-existing pancytopenia and on drugs causing pancytopenia were excluded. The study was approved by Hospital Ethical Committee.

Methodology

Temperature, heart rate, respiratory rate, CFT, blood pressure and level of conscious were assessed. SpO2 was measured with a monitor. For normal variables, score of

0 is given. For abnormal values, different weightage was allotted to each parameter as below, and SICK score was calculated. Table 2 illustrates the variables used in SICK score and the regression coefficient allotted for abnormal values.

Table 2: Variables and their regression coefficient for abnormal value in SICK score.

Parameter assessed	Score allotted
Temperature >38 or <30	1.2
HR >150	0.2
RR > 50	0.4
SpO2 <90%	1.4
SBP <75 mmHg **CFT > 3 secs**	1.2
AVPU, anything except A	2.0

On immediate assessment, using sterile techniques of cleaning the area around the identified vein with alternating spirit, betadine, spirit, the sample was collected in an EDTA tube, along with other samples, while attempting to secure the IV line. The sample was transported immediately to the Department of Pathology.

CBC was obtained from an automated haematology analyser including platelet indices like platelet count, MPV, PDW, plateletcrit. The other platelet indices ratios MPV/PCT, PDW/platelet count, MPV/platelet count were calculated. The haematology analysers which were used were Sysmex KX-21and MindRay BC-3000 plus, and they worked on the principle of Impedance method.

Platelet parameters were compared between cases and controls. They were correlated to the prognosis during the stay in hospital with reference to mortality.

RESULTS

The study was conducted in tertiary care rural hospital. A total of 66 cases requiring admission to PICU were enrolled. After initial assessment of vitals, children were classified into cases and controls depending on SICK score, with cases being SICK score≥3 and controls having sick score<3. Cases are being named as group A. Controls are being named as group B. Demographic data of the population studied is given in Table 3.

Table 3: Demographic data.

		Cases (Sick Score ≥3) n=35		Controls (Sick Score <3) n=31		P value
		Mean	**SD**	**Mean**	**SD**	
Age		6.1	2.1	5.9	2.6	0.761
Sick score		3.7	0.5	2.5	0.3	<0.001*
		Count	**%**	**Count**	**%**	
Sex	Female	15	42.9	15	48.4	
	Male	20	57.1	16	51.6	

Table 4: Comparison of platelet parameters between two groups.

	Group				P value
	Group A n=35		**Group B n=31**		
	Mean	**SD**	**Mean**	**SD**	
Platelet	124428.6	125978.1	254483.9	126742.8	<0.001*
MPV	10.0	1.4	9.0	0.7	<0.001*
PDW	12.4	2.0	9.6	1.0	<0.001*
PCT	0.1	0.0	0.3	0.1	<0.001*
MPV/PCT	118.4	73.4	35.6	11.7	<0.001*
PDW/PLT	20.4	23.7	4.5	1.8	<0.001*
MPV/PLT	17.8	23.8	4.3	1.9	0.002*

Table 5: Comparison of platelet indices between survivors and non survivors.

	Death				P value
	Alive n=64		**Death n=2**		
	Mean	**SD**	**Mean**	**SD**	
Platelet	190375.0	140822.5	30000.0	18384.8	0.115
MPV	9.5	1.2	11.8	1.1	0.006*
PDW	11.0	2.1	13.1	2.1	0.173
PCT	0.2	0.1	0.1	0.0	0.110

Continued.

	Death				P value
	Alive n=64		Death n=2		
	Mean	SD	Mean	SD	
MPV/PCT	75.3	64.5	215.0	7.1	0.003*
PDW/PLT	11.8	17.7	51.0	24.1	0.003*
MPV/PLT	10.2	17.0	49.8	34.2	0.002*

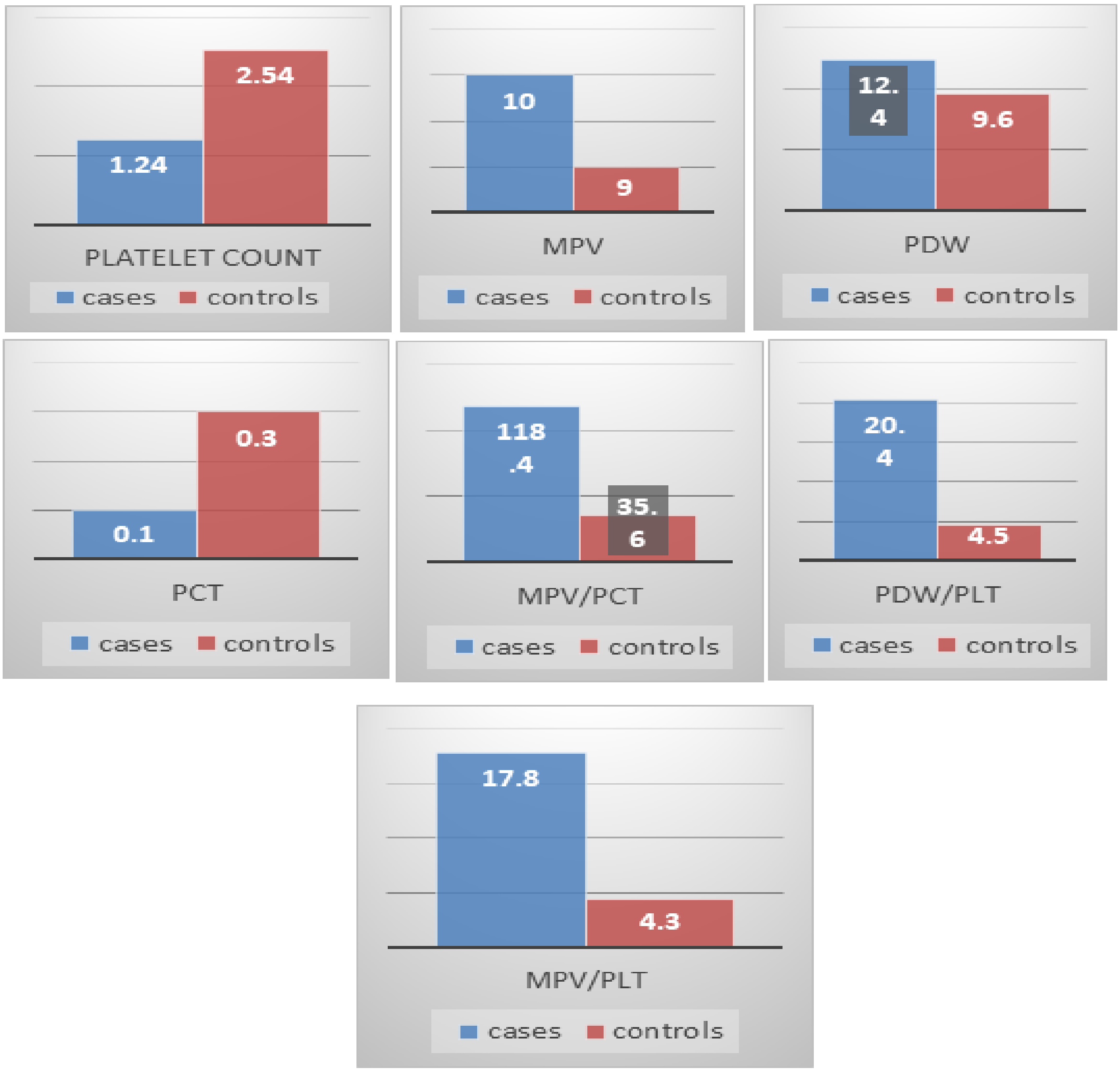

Figure 1: Platelet indices between cases and controls.

In the study there was significant difference in mean platelet count, MPV, PDW, PCT, MPV/PCT, PDW/platelet count and MPV/platelet count between two groups. Table 4 illustrates the platelet parameters in between the cases and controls and the statistical significance.

Mean Platelet count, PCT was significantly lower among cases compared to controls, whereas mean MPV, PDW, MPV/PCT, PDW/PLT and MPV/PLT was significantly higher in cases compared to controls. Figure 1 demonstrates the differences in Platelet Indices in between cases and controls.

In the study there was significant difference in mean MPV, MPV/PCT, PDW/Platelet count and MPV/Platelet count between those who were alive and died. Table 5 illustrates the differences in platelet parameters between the Survivors and non survivors and the statistical significance.

Mean MPV, MPV/PCT, PDW/platelet count and MPV/Platelet count was high among those who died compared to who were alive. There was no significant difference in platelet count, PDW, and Plateletcrit. This is probably because of the very less sample size. Figure 2 demonstrates the differences in platelet indices In between survivors and non-survivors.

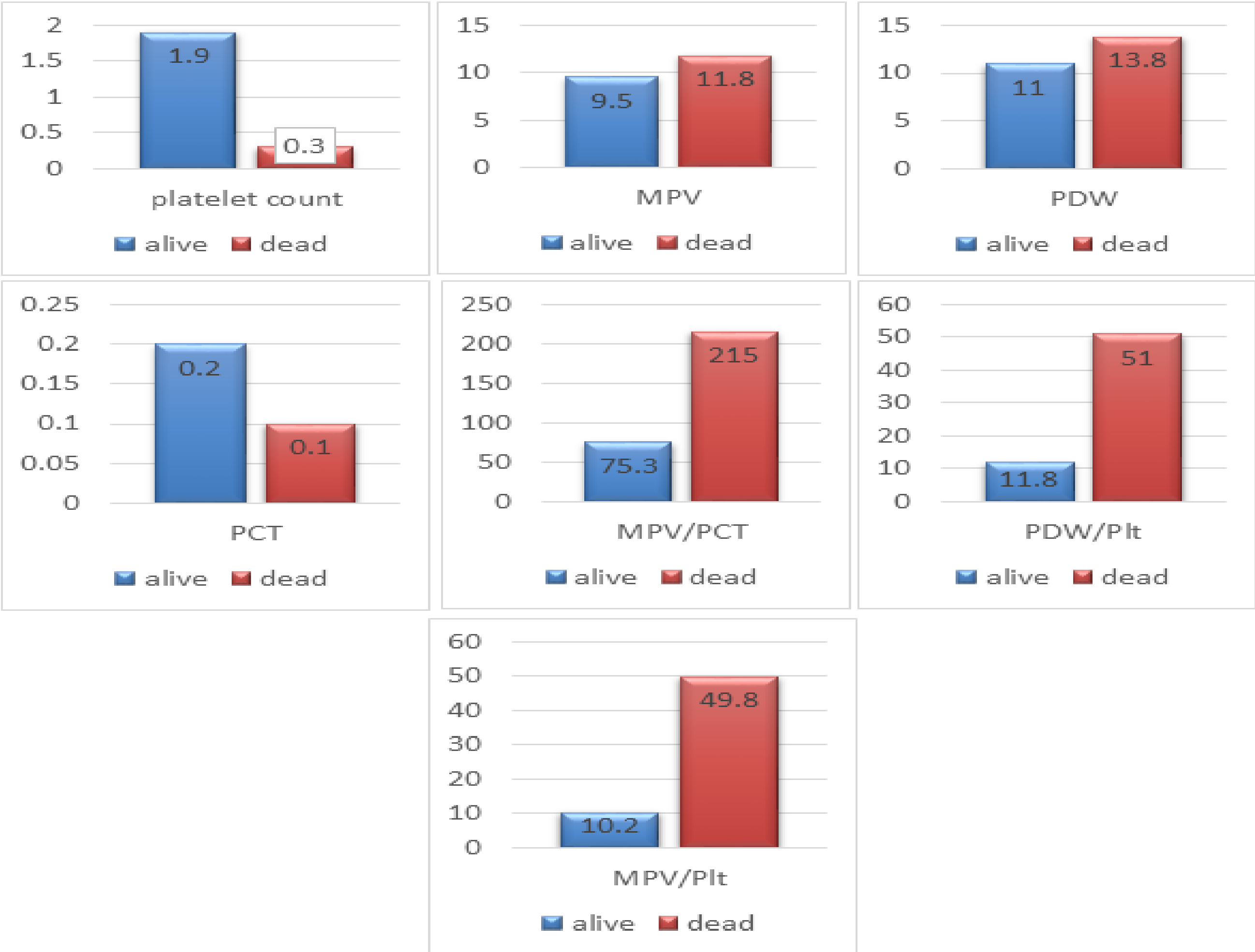

Figure 2: Platelet indices between survivors and non survivors.

DISCUSSION

Total 78 cases fulfilling the criteria were enrolled in our study. Out of them, 12 were excluded. Remaining 66 were included in the study. Based on the SICK score (cut off at 3), they were classified as SICK (group A) and non-sick (group B). 35 children were categorized into group A and 31 children were categorized into group B.

Mean age among group A is 6.1 years. Mean age among group B is 5.9years. Out of 35 children in group A, 20 (57.1%) children were males and 15 (42.9%) children were females. Out of 31 children in group B, 16 (51.6%) children were males and 15 (48.4%) children were males. There was no statistically significant difference in age and gender among the two groups. Among group A, 2 (5.7%) children died. Among group B, 0 children died. Platelet parameters were compared between the two groups. There was statistically significant difference in Platelet count, MPV, PDW, PCT, MPV/PCT, MPV/platelet count, PDW/platelet count. Platelet parameters were compared between Survivors and non survivors. There was statistically significant difference in MPV, MPV/PCT, MPV/platelet count, PDW/Platelet count. There was no significant difference in Platelet count, PDW, plateletcrit among survivors and non survivors, probably because of less sample size.

Golwala et al, studied difference in platelet indices between survivors and non survivors. They found significant difference in Platelet count, PCT, MPV/PCT, MPV/Platelet count, PDW/Platelet count, PDW/PCT among survivors and non survivors.[15]

Guclu et al found that MPV and PDW were significantly elevated among sepsis children compared to controls. Platelet count, MPV, PDW were significantly altered in the two groups–sepsis and severe sepsis. And on comparison in between survivors and non survivors, PDW was the only parameter which was significantly elevated.[16]

Limitations

The study was done with a total of 66 participants and further categorized into Sick and Non sick based on sick score alone. However, there are other parameters which would indirectly influence platelet indices like specific disease states, for example, dengue, which was not considered. A large multicenteric study with special reference to disease states would remove the confounding factors and clearly determine the variation of Platelet parameters in a sick child.

CONCLUSION

Prognostic classification of sick children is a vital event in the management of ICU. Various scoring and lab investigations help in the same. Of which, platelet count and its other parameters like MPV, PDW and their ratios like, MPV/PCT, MPV/platelet count, PDW/platelet count were important predictor of mortality. Though platelet count is also predictor of mortality, other parameters were excellent predictors of mortality as well as morbidity. Hence, evaluation of platelet parameters should be done in all ICU patients. More intensive care can be targeted to those who have significant variation in the platelet parameters.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. Féry-Lemonnier E, Landais P, Loirat P, Kleinknecht D, Brivet F. Evaluation of severity scoring systems in ICUs--translation, conversion and definition ambiguities as a source of inter-observer variability in Apache II, SAPS and OSF. Intensive Care Med. 1995;21(4):356-60.
2. Chang RW, Jacobs S, Lee B. Use of APACHE II severity of disease classification to identify intensive-care-unit patients who would not benefit from total parenteral nutrition. Lancet. 1986;1(8496):1483-7.
3. Wagner DP, Knaus WA, Draper EA, Zimmerman JE. Identification of low-risk monitor patients within a medical-surgical intensive care unit. Med Care. 1983;21(4):425-34.
4. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. Prognosis in acute organ-system failure. Ann Surg. 1985;202(6):685-93.
5. Chang RW. Individual outcome prediction models for intensive care units. Lancet.1989;2(8655): 143-6
6. Yeh TS, Pollack MM, Ruttimann UE, Holbrook PR, Fields AI. Validation of a physiologic stability index for use in critically ill infants and children. Pediatr Res. 1984;18(5):445-51.
7. Pollack MM, Ruttimann UE, Getson PR. Pediatric risk of mortality (PRISM) score. Crit Care Med. 1988;16(11):1110-6.
8. Kumar N, Thomas N, Singhal D, Puliyel JM, Sreenivas V. Triage score for severity of illness. Indian Pediatr. 2003;40(3):204-10.
9. Gupta MA, Chakrabarty A, Halstead R, Sahni M, Rangasami J, Puliyel A et al. Validation of "Signs of Inflammation in Children that Kill" (SICK) score for immediate non-invasive assessment of severity of illness. Ital J Pediatr. 2010;36:35.
10. Rajeshwari N, Savitha A. Evaluation of Signs of Inflammation that Can Kill score in predicting mortality in an urban tertiary care centre for children in South India. Int J Contemp Pediatr. 2020;7(6):1204-7
11. Bhal S, Tygai V, Kumar N, Sreenivas V, Puliyel JM. Signs of inflammation in children that can kill (SICK score): preliminary prospective validation of a new non-invasive measure of severity-of-illness. J Postgrad Med. 2006;52(2):102-5.
12. Klinger MH, Jelkmann W. Role of blood platelets in infection and inflammation. J Interferon Cytokine Res. 2002;22(9):913-2.
13. Vanderschueren S, De Weerdt A, Malbrain M, Vankersschaever D, Frans E, Wilmer A, et al. Thrombocytopenia and prognosis in intensive care. Crit Care Med. 2000;28(6):1871-6.
14. Vagdatli E, Gounari E, Lazaridou E, Katsibourlia E, Tsikopoulou F, Labrianou I. Platelet distribution width: a simple, practical and specific marker of activation of coagulation. Hippokratia. 2010;14(1):28-32.
15. Golwala ZM, Shah H, Gupta N, Sreenivas V, Puliyel JM. Mean Platelet Volume (MPV), Platelet Distribution Width (PDW), Platelet Count and Plateletcrit (PCT) as predictors of in-hospital paediatric mortality: a case-control Study. Afr Health Sci. 2016;16(2):356-62.
16. Guclu E, Durmaz Y, Karabay O. Effect of severe sepsis on platelet count and their indices. Afr Health Sci. 2013;13:333-8.

Cite this article as: Rani VV, Balasundaram R. Study of platelet parameters in sick children. Int J Contemp Pediatr 2021;8:522-7.