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Original Research Article

Study of Various Platelet Indices in Patients of Sepsis and Correlation of Platelet Count and Indices with Severity of Sepsis

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Abstract:

Aim: The objective of the study was to assess the various platelet indices - Mean platelet volume (MPV), Platelet distribution width (PDW), Plateletcrit (PCT) and Platelet large cell ratio (PLCR) in patients of sepsis and correlation of platelet count and indices with severity of sepsis.

Methods: The present study was conducted in the Department of General Medicine, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India and total of 60 patients of either sex admitted to a Department of General Medicine, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India with clinical features, lab investigations and/or radiological features suggestive of sepsis were enrolled over a period of one year.

Results: Mean Respiratory rate in Group I patients is 22.69±1.61 and among Group II patients is 29.92±3.407. On statistical analysis it was found to be significant ($p < 0.01$). Mean values of diastolic B.P in group I & II (80.66±10.5 & 62.42±4.97 respectively) were also statistically significant. Similarly mean values of systolic B.P among the two groups were also found to be statistically significant. Mean hemoglobin in the Survivors group and Non survivors' group was 12.62±2.21 and 9.51±1.16 respectively. The values on statistical analysis were found to be significant ($p < 0.01$). Mean Total Leucocyte count value among the two groups was 13.22±1.31 and 17.78±2.601 respectively. It also came out to be statistically significant.

Conclusion: Our study reported statistically significant decreased levels of mean platelet counts among the patients who expired (Non survivors) due to sepsis as compared to the patients who Survived sepsis (Survivors). The study also reported statistically significant increased levels of Mean platelet volume and Mean platelet distribution width among the Non survivors' group as compared to the Survivors group.

Keywords: platelet indices, sepsis, neonatal.

Introduction

Neonatal sepsis is an important cause of neonatal morbidity and mortality worldwide. However, it is diagnostic challenge as there are overlapping signs and symptoms which preclude a specific diagnosis of sepsis. So, we have to rely on investigations to guide us. Blood culture has always been the gold standard for the diagnosis of neonatal sepsis. It has been noted that only 20% of symptomatic neonates with suspected early-onset sepsis (EOS) have a positive blood culture, and

only 30% neonates clinically suspected to have late-onset sepsis (LOS) in neonatal intensive care unit (NICU) setting have a positive blood culture.[1,2] However, the blood culture report is available too late and it cannot be relied upon for making immediate decisions. To overcome these limitations, we usually rely on sepsis screening. But it has a variable sensitivity and specificity. The negative predictive value of these parameters is too low to confidently rule out sepsis.[3,4] The limitations of blood culture, its low positivity rates, and poor diagnostic capability of sepsis screen in neonates make the diagnosis of sepsis difficult, and thus the need for better diagnostic parameters arises. There have been studies showing significant changes in platelet indices in patients with neonatal sepsis.[5-7]These studies have measured platelet count, mean platelet volume (MPV), and platelet distribution width (PDW). It has been shown by these studies that platelet count decreases and MPV and PDW increases in neonates with sepsis.[6] Platelet indices are a group of parameters that are used to measure the total amount, morphology and proliferation kinetics of platelets. The commonly used platelet indices include platelet count, mean platelet volume (MPV), platelet distribution width (PDW), and Plateletcrit (PCT). Mean platelet volume is a measure of the average size of platelets. Platelet Distribution width is an indicator of volume variability in platelets size and is increased in the presence of platelet anisocytosis. Platelet crit is the volume occupied by platelets in the blood as a percentage. In recent years, the number of studies suggesting that the platelet and their indices can be used as inflammatory markers in cancer cases in addition to cardiovascular, cerebrovascular, inflammatory and thromboembolic diseases is increasing by the time.[8] Originally, these indices have been applied in the diagnosis of hematological diseases. Recently, it has been discovered that these indices are related to the severity of illness and patient's prognosis. A reduction in platelet count is an independent risk factor for critically ill patients in intensive care unit.[9] In addition, Acute Physiology and Chronic Health Evaluation II (APACHE II) System also includes thrombocytopenia as an independent risk factor for mortality.[10] However, whether other PLT indices are associated with the severity of illness and patient's prognosis is still under exploration. Thus, we conducted a prospective study to explore whether platelet indices could be used to determine the severity of illness in sepsis patients.

Materials and Methods

The present study was conducted in the Department of General Medicine, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India. and total of 60 patients of either sex admitted to a Department of General Medicine, Lord Buddha Koshi Medical College and Hospital, Saharsa, Bihar, India with clinical features, lab investigations and/or radiological features suggestive of sepsis were enrolled over a period of one year.

Methodology

Diagnosis of Sepsis was established with the help of SIRS criteria. Routine and specific lab investigations pertaining to our study were performed. Complete Hemogram was done by the Automatic cell counter installed in the Pathology department of our institute. Investigation reports of the patients who survived sepsis (Survivors) and who expired due to sepsis (non-survivors) were compared statistically. The data was coded and entered into Microsoft Excel spreadsheet.

Descriptive statistics including computation of percentages, means and standard deviations were done. The independent (unpaired or student`s) t test (for quantitative data within two groups) was used for quantitative data comparison of all clinical indicators. Chi-square test

was used for qualitative data whenever two or more than two groups were used to compare.

Level of significance was set at P≤0.05. Patients with concomitant hematological diseases (e.g. hematological malignancies, autoimmune thrombocytopenic purpura and reactive thrombocytosis) and pregnant or breastfeeding patients were excluded from the study.

Results

Table 1: Vital Parameters of Survivors and Non-Survivors

Parameters	Group I (n=42) (Survivors)	Group II (n-18) (Non survivors)	p value
Pulse Rate (per min)	100.13±8.58	103.5±9.24	0.23
Respiratory Rate (per min)	22.69±1.61	29.92±3.40	0.001
SBP (mm of Hg)	125.61±15.1	86.14±13.48	0.001
DBP (mm of Hg)	80.66±10.05	62.42±4.97	0.001
Body Temperature (*F)	99.80±1.42	99.65±0.93	0.65

The result shows the vital parameters of all the patients which were noted at the time of enrollment in the study. Mean Respiratory rate in Group I patients is 22.69±1.61 and among Group II patients is 29.92±3.407. On statistical analysis it was found to be significant (p <0.01). Mean values of diastolic B.P in group I & II (80.66±10.5 & 62.42±4.97 respectively) were also statistically significant. Similarly mean values of systolic B.P among the two groups were also found to be statistically significant.

Table 2: Complete Hemogram of Group I (Survivors) and Group II (Non survivors)

Investigations	Group I (n=42) (Survivors)	Group II (n-18) (Non survivors)	p value
Hemoglobin (g/dL)	12.62±2.21	9.51±1.16	0.001
Total Leucocyte Count (103 per cu mm)	13.22±1.31	17.78±2.601	0.001
Neutrophils %	72.58±73.07	73.07±8.77	0.84
Lymphocyte %	19.58±6.74	18.21±7.35	0.52
Monocyte %	4.19±2.37	5.07±2.49	0.25
Eosinophils %	1.77±0.92	1.92±1.14	0.62
RBC count (106 per cu mm)	4.16±0.73	3.45±0.604	0.001
Mean Corpuscular Volume (MCV), fL	86.52±7. 12	85.92±8.39	0.8
Mean Corpuscular Hemoglobin (MCH)	28.88±3.02	27.42±2.76	0.12
Mean Corpuscular Hemoglobin Concentration (MCHC), g/dL	32.44±2.54	32.07±2.61	0.64
Hematocrit	36.13±6.66	30.28±4.41	0.001

Table 2 illustrates the Complete Hemogram of the patients. Mean hemoglobin in the Survivors group and Non-survivors' group was 12.62±2.21 and 9.51±1.16 respectively. The values on statistical analysis were found to be significant (p <0.01). Mean Total Leucocyte count value among the two groups was 13.22±1.31 and 17.78±2.601 respectively. It also came out to be statistically significant.

Table 3: Platelet Count, Mean platelet volume, Platelet Distribution Width and Plateletcrit among Survivors and Non survivors

Investigations	Group I (n=42) (Survivors)	Group II (n-18) (Non survivors)	p value
Platelet Count (103 per cu mm)	203.305±39.24	121.92±43.55	0.001
Mean Platelet Volume (MPV), fL	8.72±0.96	11.46±0.98	0.001
Mean Platelet distribution width	12.79±2.02	15.67±0.85	0.001
Mean Plateletcrit (%)	0.23±0.05	0.19±0.07	0.1

Mean platelet counts in the Group I (Survivors group) and Group II (Non survivors group) were 203.305±39.84 and 121.92±43.55 respectively. In group I, MPV was 8.72±0.96 and in group II, it was 11.46±0.98. In group I, mean PDW was 12.79±2.02 and in group II, it was 15.67±0.85. The values on statistical analysis were found to be significant (p <0.01). In group I, it was 0.23±0.05 and in group II, it was 0.19±0.07. On statistical analysis, the difference among both the groups was found to be comparable and thus statistically insignificant (p >0.05).

Discussion

Sepsis is a major childhood disease both in terms of frequency and severity, and severe sepsis is still considered the main cause of death from infection in childhood. The prevalence of severe sepsis and septic shock among hospitalized children ranges from 1 to 26%. Mortality is high, ranging from 5% in developed countries reaching up to 35% in developing countries.[11] Although sepsis is considered a worldwide public health problem, it is still not tracked in the Global Burden of Disease report published by the WHO and World Bank[12], which is one of the most important sources of information for health policies decision making in the world.[13]

The platelets are intimately involved in the pathogenesis of sepsis, participating in the immune response and interacting with bacteria. Platelet abnormalities occur frequently in critical illness, especially in septic patients, and are associated with poorer outcomes.

Dhananjay et al[14] observed that platelet count in subjects developing sepsis are significantly less than platelet count of those not developing sepsis. In our study, among Survivors and Non survivors groups, the Mean platelet count were 203.305±39.24 and 121.92±43.55 respectively (p value 0.01) i.e. significantly lower platelet counts were seen in patients who expired during the course of treatment. The findings are in concordance with the studies by Sheng Zhang et al study.[15]

The Mean platelet volume among the Survivors and Non survivors group in the present study were 8.72±0.96 and 11.46±0.98 respectively. P value was 0.001 i.e. statistically significant. Our observation is in tune with results of many studies on the subject. Vanderlelie et al.[16] showed that mean platelet volume (MPV) was elevated in 13 of the 25 septicemia patients and returned to normal values as soon as the disease was under control. In new born cohorts with sepsis study by Guida et al.[17], thrombocytopenia and high MPV appeared to be prominent. They suggested that an elevated MPV indicates that the infection is invasive, systemic and uncontrolled and is related to the severity of the disease and therefore MPV may be a useful assessment tool for prognostic features of septic shock.

Platelet indices are a group of indices that are used to measure the platelet count and platelet morphology. Under physiological conditions, the number of platelets in blood can be maintained in an equilibrium state by regeneration and elimination. Thus, either the platelet or their morphology remains relatively constant. Under Patho-

physiological conditions, any factor which could inhibit platelet regeneration, increase their activation or accelerate their death once overwhelming the capacity of self-regulation will cause changes in both platelet count and morphology and thus results in a change in platelet indices.[18] Researches have shown that activation of the coagulation system, severe infection, trauma, systemic inflammatory reaction syndrome and thrombotic diseases could all result in changes in platelet indices. Plateletcrit is the arithmetic product of platelet count and platelet volume. A reduction of platelet count and plateletcrit simultaneously indicates that platelets have been excessively consumed. When platelets have been excessively consumed, bone marrow will produce a large amount of immature platelets which have larger volume than mature ones.

At that time, both newly produced platelets with large volume and mature platelets with small volume simultaneously present in the blood, therefore, both mean platelet volume and platelet distribution width (coefficient of platelet size variation) will be increased correspondingly.[19] Thus, instead of only measuring platelet count as has been done previously, to measure all of the platelet indices, will provide us a more comprehensive view of sepsis severity.

Conclusion

In conclusion the present study reported statistically significant decreased levels of mean platelet counts among the patients who expired (Non survivors) due to sepsis as compared to the patients who Survived sepsis (Survivors). The study also reported statistically significant increased levels of Mean platelet volume and Mean platelet distribution width among the Non survivors' group as compared to the Survivors group.

Thus, the values of these parameters (platelet count and platelet indices) which are readily available as quick, cheap, easy to do tests across all the tertiary health centers worldwide, should be carefully monitored in patients with sepsis. It was also demonstrated in our study that the parameters can act as valuable markers in accessing the severity and predicting the prognosis in patients of sepsis. Further studies are recommended to confirm the correlation of platelet count & various other platelet indices with the severity of sepsis.

References

1. Okascharoen C, Sirinavin S, Thakkinstian A, Kitayaporn D, Supapanachart S. A bedside prediction-scoring model for late-onset neonatal sepsis. Journal of perinatology. 2005 Dec; 25(12):778-83.
2. Singh SA, Dutta S, Narang A. Predictive clinical scores for diagnosis of late-onset neonatal septicemia. Journal of tropical pediatrics. 2003 Aug 1; 49(4):235-9.
3. Philip AG, Hewitt JR. Early diagnosis of neonatal sepsis. Pediatrics. 1980 May; 65(5):1036-41.
4. Gerdes JS, Polin RA. Sepsis screen in neonates with evaluation of plasma fibronectin. The Pediatric infectious disease journal. 1987 May 1; 6(5):443-6.
5. Patrick CH, Lazarchick J. The effect of bacteremia on automated platelet measurements in neonates. American journal of clinical pathology. 1990 Mar 1; 93(3):391-4.
6. Castle V, Andrew M, Kelton J, Giron D, Johnston M, Carter C. Frequency and mechanism of neonatal thrombocytopenia. The Journal of pediatrics. 1986 May 1; 108(5):749-55.
7. Tate DY, Carlton GT, Johnson D, Sorenson RL, Nesbit M, White J, Thompson T, Krivit W. Immune thrombocytopenia in severe neonatal infections. The Journal of pediatrics. 1981 Mar 1; 98(3):449-53.
8. Chu SG, Becker RC, Berger PB, Bhatt DL, Eikelboom JW, Konkle B, et al. Mean platelet volume as a predictor of cardiovascular risk: a systematic review

and meta-analysis. J Thromb Haemost. 2010; 8(1):148–56.
9. Sezgi C, Taylan M, Kaya H, Selimoglu Sen H, Abakay O, Demir M, et al. Alterations platelet count and mean platelet volume as predictors of patient outcome in the respiratory intensive care unit. Clin Respir J. 2015(10); 9(4):403-8
10. Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II. A severity of disease classification system. Crit Care Med. 1985; (10)13 :818-29.
11. de Souza DC, Machado FR. Epidemiology of pediatric septic shock. J Pediatr Intensive Care. 2019; 8(1):3–10.
12. World Bank. World development report 1993 — investing in health: world development indicators. Oxford: Oxford University Press; 1993.
13. Murray CJ, Lopez AD. Measuring the global burden of disease. N Engl J Med. 2013; 369:448–57.
14. Dhananjay BS, Nanda SK. Comparison of biochemical and pathological markers in neonates with sepsis and neonates without sepsis. Int J Biol Med Res. 2011; (4):1131-34.
15. Zhang S, Cui YL, Diao MY, Chen DC, Lin ZF. Use of platelet indices for determining illness severity and predicting prognosis in critically ill patients. Chinese medical journal. 2015 Aug 5; 128(15):2012-8.
16. Van der lelie J, Von dem Borne A K. Increased MPV in septicaemia. J Clin Pathol. 1983; 36(6):693-96
17. Guida JD, Kunig AM, Leef KH, Mckenzie SE, Paul DA. Platelet count and sepsis in very low birth weight neonates; is there an organism specific response? Pediatrics. 2003; 111(6): 1411-5.
18. Gadó K, Domján G. Thrombocytopenia. Orvosi Hetilap. 2014 Feb 1; 155(8):291-303.
19. Zhang Z, Xu X, Ni H, Deng H. Platelet indices are novel predictors of hospital mortality in intensive care unit patients. Journal of critical care. 2014 Oct 1; 29(5):885-e1.