International Journal of Medicine Research
ISSN: 2455-7404; Impact Factor: RJIF 5.42
Received: 09-01-2018; Accepted: 11-02-2019
www.medicinesjournal.com
Volume 4; Issue 2; April 2019; Page No. 12-15

Evaluation of platelet count and indices in patients of sepsis

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Abstract

Introduction: Platelet indices like Mean Platelet volume (MPV), are readily available blood tests, although their prognostic value in patients with sepsis has not been fully explored. This study aims to explore the behavior of platelet indices in sepsis and their clinical prognostic value.

Aim and Objectives: To study 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.

Material and Methods: A total of 50 patients diagnosed with Sepsis were included in the study. All of them were thoroughly evaluated in terms of routine and specific biochemical investigations and complete blood count including platelet indices like mean platelet volume (MPV), platelet distribution width (PDW), plateletcrit (PCT) and platelet large cell ratio (PLCR). To establish the diagnosis of Sepsis, SIRS (Systemic Inflammatory Response Syndrome) criteria were followed. The cases were divided into Survivors and Non survivors (who expired during the treatment process).

Results: Mean platelet counts in the Survivors group and Non-survivors group were 203.305±39.84 x 10^9/L and 121.92±43.55 x 10^9/L respectively. The Mean platelet volume among the Survivors and Non-survivors group in the present study were 8.72±0.96 fL and 11.46±0.98 fL respectively. Mean Platelet distribution width value in Survivors group was 12.79±2.02 and in Non-survivors groups it was 15.67±0.85. The Mean plateletcrit values in Survivor and Non-survivor group were 0.23±0.05 % and 0.19±0.07 % respectively. The p value was found to be significant in case of Platelet counts, MPV and PDW among the Survivors and Non-survivors group

Conclusion: A statistically significant difference was seen between survivors and non-survivors for platelet indices which make the platelet indices easily available, cheap and useful prognostic markers for patients in septic shock.

Keywords: platelet indices, sepsis

1. Introduction

Sepsis is a major healthcare problem affecting millions of people worldwide each year. Approximately 7,50,000 cases of sepsis per year were seen in the United States (US) and led to 2,15,000 deaths [1]. The economic burden of this disease for the US is about 16.7 billion US dollars/year. In resource-limited settings such as India, sepsis is still a common cause of morbidity and mortality. Sepsis was defined as systemic inflammatory response syndrome (SIRS) with a proven or suspected source of infection. The Third International Consensus, 2016 defines sepsis as a life-threatening organ dysfunction caused by a dysregulated patient response to infection.

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. Plateletcrit is the volume occupied by platelets in the blood as a percentage

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 [2]. In addition, Acute Physiology and Chronic Health Evaluation II (APACHE II) System also includes thrombocytopenia as an independent risk factor for mortality [3]. 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.

2. Aim and Objectives

To study the platelet count and indices - Mean Platelet volume (MPV), Platelet Distribution width (PDW), Plateletcrit (PCT) in patients of sepsis and to correlate with severity of sepsis.

3. Material and Methods

A total of 50 patients of either sex admitted to a tertiary health centre in Haryana with clinical features, lab investigations and/or radiological features suggestive of sepsis were enrolled over a period of one year. They constituted our study group. 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 $P \leq 0.05$. 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.

4. Results and Observations

The present study was undertaken in the Department of Medicine in a tertiary health centre in Haryana from January 2017 to April 2018. During this period 50 patients diagnosed with sepsis were studied in a prospective way. Various observations made during the statistical analysis were as follows:

Table 1: Vital Parameters of Survivors and Non Survivors

Parameters	Group I (n=36) (Survivors)	Group II (n-14) (Non survivors)	Statistical significance (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±3.407	**0.001(S)**
SBP (mm of Hg)	125.61±15.1	86.14±13.48	**0.001(S)**
DBP (mm of Hg)	80.66±10.05	62.42±4.97	**0.001(S)**
Body Temperature (*F)	99.80±1.42	99.65±0.93	0.65

Table 1 show 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=36) (Survivors)	Group II (n-14) (Non Survivors)	Statistical significance
Hemoglobin (g/dL)	12.62±2.21	9.51±1.16	**0.001 (S)**
Total Leucocyte Count (10^3 per cu mm)	13.22±1.31	17.78±2.601	**0.001 (S)**
Neutrophils %	72.58±73.07	73.07±8.77	0.82
Lymphocyte %	19.58±6.74	18.21±7.35	0.53
Monocyte %	4.19±2.37	5.07±2.49	0.25
Eosinophils %	1.77±0.92	1.92±1.14	0.63
RBC count (10^6 per cu mm)	4.16±0.73	3.45±0.604	**0.001 (S)**
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 (S)**

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 among Survivors and Non survivors

Investigations	Group I (n=36) (Survivors)	Group II (n=14) (Non Survivors)	Statistical significance (p value)
Platelet Count (10^3 per cu mm)	203.305±39.24	121.92±43.55	0.001 (S)

Table 3 demonstrates the platelet count of the patients among the Group I & Group II. 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. The values on statistical analysis were found to be significant ($p < 0.01$).

Table 4: Mean platelet volume among Survivors and Non survivors

Investigations	Group I (n=36) (Survivors)	Group II (n-14) (Non Survivors)	Statistical significance (p value)
Mean Platelet Volume (MPV), fL	8.72±0.96	11.46±0.98	**0.001 (S)**

Table 4 depicts Mean platelet volume (MPV) of both the groups. In group I, MPV was 8.72±0.96 and in group II, it

was 11.46±0.98. On statistical analysis, the values were found to be statistically significant (P<0.01).

Table 5: Platelet Distribution Width among Survivors and Non survivors

Investigations	Group I (n=36) (Survivors)	Group II (n-14) (Non Survivors)	Statistical significance (p value)
Mean Platelet distribution width	12.79±2.02	15.67±0.85	0.001 (S)

Table 5 illustrates mean Platelet distribution width (PDW) of both the groups. In group I, mean PDW was 12.79±2.02 and in group II, it was 15.67±0.85. On statistical analysis, the difference among both the groups was found to be statistically significant (p <0.01).

Table 6: Plateletcrit among survivors and Non survivors

Investigations	Group I (n=36) (Survivors)	Group II (n-14) (Non survivors)	Statistical significance
Mean Plateletcrit (%)	0.23±0.05	0.19±0.07	0.1**(NS)**

Table 6 shows mean plateletcrit of both the groups. 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).

5. Discussion

Our study is one of the few researches done in the field to explore the possibility of usefulness of platelet count and their indices to measure the severity of sepsis and predict the prognosis in indoor sepsis patients. In our study, we took 50 indoor patients having sepsis admitted in Medicine wards and ICU. In our study out of total 50 patients, 36 (72%) patients survived and 14 (28%) patients expired during the treatment process.

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.* [4] 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.* [5] study. The platelet count among the two groups in sheng Zhang *et al.* [5] study were 196.5 ± 103.3 and 141.1 ± 48.3 and the p value was 0.001.

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.* [6] in 1983 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 a new born cohorts with sepsis study by Guida *et al.* [7] in 2003, 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 amount 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 [8]. 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 [9]. 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.

6. 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. These finding are consistent with many other studies done on the subject internationally, as already described. 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.

7. References

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