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Original Research Article

Study of hematological parameters in sepsis patients and its prognostic implications

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ABSTRACT

Background: Septic response is a leading contributory factor for morbidity and mortality especially in intensive care settings. The current research aims to study the co-relation of various hematological parameters in sepsis patients with the objective to see their effects in prognosis of sepsis patients.
Methods: The current study was a cross-sectional study with a sample size of 117 patients with sepsis. Various hematological parameters of all the patients were obtained on day of admission (day 1) and seventh day (day 7) using hemogram reports and the difference of their statistical mean and standard deviation was estimated.
Results: There was a significant statistical difference in the mean and standard deviation of neutrophil lymphocyte count ratio (NLCR), red cell distribution width standard deviation (RDW SD), Platelet count (PLT) and Platelet crit (PCT) whereas Mean platelet volume (MPV), Platelet distribution width (PDW) and Platelet large cell ratio (PLCR) showed no significant changes on day 1 and day 7 of observation in patients taken for the study.
Conclusions: The prognosis of sepsis can be important when we can clinch the hemogram markers early in the period of sepsis and evaluate them according to the etiology of the respective incidences. Targeted approach can be initiated early in the course of hospitalization and may be a specific index of hemogram could be established to further co relate sepsis and its form in particular diseases.

Keywords: Hemogram, Neutrophil lymphocyte count ratio, Platelet indices, Prognosis, Red cell distribution width, Sepsis

INTRODUCTION

There are various physiologic, pathologic and biochemical abnormalities caused by infection which cumulate and lead to sepsis. The clinical signs that define systemic inflammatory response syndrome (SIRS) are present in sepsis and are due to either a culture-proven infection or an infection identified clinically. SIRS is defined by at least two of four defined parameters namely body temperature of >38˚C or <36˚C, leucocyte count of >12,000 cells/ cumm or <4000 cells/ cumm, heart rate >90/min, and respiratory rate of >24/min.[1] If these symptoms are complicated by organ dysfunction and persistent arterial hypotension, the definition of "severe sepsis" and "septic shock" respectively are fulfilled. Severe sepsis exists if there is sepsis plus sign of organ hypoperfusion or dysfunction. Septic shock exists if there is severe sepsis plus one or both of: systemic mean blood pressure is <60mmHg (or <80mmHg if the patient has baseline hypertension) despite adequate fluid resuscitation and maintaining the systemic mean blood pressure>60mmHg (or>80mmHg if the patient has

baseline hypertension) requires dopamine >5mcg/kg/min, norepinephrine <0.25mcg/kg/min, or epinephrine <0.25mcg/kg/min despite adequate fluid resuscitation.[1] The mortality in patients with severe sepsis ranges from 28 to 50% or greater. In USA, incidence of sepsis rose by 7-8% over a period of 8 years. According to the Indian intensive care case mix and practice patterns study (INDICAPS), mortality in sepsis in India is 42.2%.

Early diagnosis of sepsis is vital because rapid, appropriate therapy is associated with improved outcome.[2] There are various hematological parameters that work as biomarkers for the prognosis of sepsis. The current study was aimed to find the prognostic implications of seven hematological parameters i.e. NLCR, RDW SD, MPV, PDW, PLCR, PLT and PCT, which had been previously supported by various other studies. Low NLCR is found in early death and high NLCR in late death in patients with sepsis.[3] RDW levels measured on admission can be used as a prognostic marker in patients with severe sepsis and septic shock.[4] An increase in MPV in patients with sepsis had been shown in a study.[5] PDW and PLCR show increased trends, while PCT and PLT decrease in the non-survivor group.[6]

METHODS

The present study is a cross-sectional observational study done at Netaji Subhash Chandra Bose Medical College, Jabalpur between March 2017 to August 2018.

The study was conducted in 117 patients with sepsis after obtaining permission from the Institutional ethics committee. Sample size was determined by using the formula z^2pq/d^2 considering the prevalence rate of sepsis as 25%. All the patients in the study were diagnosed with sepsis (selection done on the basis of TLC >12,000, <4000, temperature >38°C or <36°C, heart rate >90per min, respiratory rate > 24 per min) and required admissions in either intensive care unit or wards of the hospital for more than seven days.

The patients were observed from the day of admission (day 1) up to the primary end point, defined as either discharged or death during course of hospitalization.

Procedure

All subjects after screening for inclusion and exclusion criteria were asked for detailed history after obtaining their consent in a prescribed consent form. Their complete hemogram was obtained by taking 2ml of blood sample from the anticubital vein of the patients after all aseptic precautions. Samples were collected in EDTA vials, kept at room temperature. The printout reports of samples fed to MINDRAY-BC 3600 autoanalyzer were collected and analyzed. The results of all the patients were pooled and various hematological parameters were obtained. Data was recorded for all patients in a prescribed proforma. Among the various hematological parameters, further meticulous observation was carried out for seven parameters.

Statistical analysis

All the records were rechecked for their completeness. Non-numeric entries were coded numerically into nominal/ordinal distribution using SPSS software before analysis. Continuous variable was analyzed using mean ±standard deviation (SD) with inter quartile range as appropriate. Mean difference between two independent groups (day 1 and day 7) were analyzed by using independent paired t-test after the normalized distribution otherwise non-parametric test was applied.

Odds ratio with 95% confidence limits were analyzed to find out the potential risk factors. For testing the null hypothesis, critical value for alpha 0.05 (type I error) and 95% confidence limit was applied.

RESULTS

A significant difference in the mean and SD of NLCR in the survivor and total patient groups was observed on day 1 and day 7 which indicates its positive prognostic implication in patients with sepsis. There was a significant increase in RDW SD in the non-survivor group with no statistical level of significance for the total and survivor group of septic patients. There were no significant differences in the mean and SD values of MPV, PDW and PLCR on observation day 1 and 7 which summarizes that they had no considerable prognostic implication in patients with sepsis.

However, there was a significant difference in PLT in the statistical paired comparison of mean and SD on day 1 and 7 of observation in survivor group with no remarkable variations in the total and non-survivor group.

A noticeable statistical difference in the PCT mean and SD values of observation on day 1 and 7 was obtained in the total and survivor group with no significant differences in the respective values of non-survivor group in patients with sepsis (Table 1).

DISCUSSION

In this study, 66 patients (56.41%) were males and 51 patients (43.58%) were females.

This finding can be correlated with the fact that in general, admission rates in our hospital were higher for males than females.

Also, in Indian rural setup exposure to environmental and other factors which will directly or indirectly facilitate sepsis process is more for males than females. However, there can be other factors responsible for this such as co morbid conditions in males and immunological factors

that need to be studied. In survivor group, 51 patients i.e. 54.25% were male and 43 patients i.e. 45.74% were female. In non-survivor group 15 patients i.e. 62.21% were male and 08 patients i.e. 45.74% were female (Figure 1). In the study of Padkin et al, there was a predominance of men (58.8%) in their cohort of patients with severe sepsis.[7] In a study by Sinha M et al, male patients were more with male-female ratio of 28:12.[8] Most of the patients in the study population were in the age group of 46 to 60 years i.e. 32 patients (27.35%) (Figure 2).

Table 1: Mean and SD on day 1 and day 7 along with their p values for total, survivor and non-survivor groups.

Parameter	Group	Day 1 Mean±SD	Day 7 Mean±SD	P value
NLCR	Total	9.40±9.21	6.95±5.67	0.003
	Survivor	8.44±8.46	5.75±4.37	0.002
	Non-survivor	13.29±11.14	11.88±7.57	0.514
RDW SD	Total	58.52±9.84	59.50±10.01	0.151
	Survivor	59.05±10.37	59.59±10.60	0.483
	Non-survivor	56.39±7.11	59.11±7.29	0.043
MPV	Total	10.51±1.71	11.36±8.00	0.260
	Survivor	10.39±1.76	11.49±8.90	0.243
	Non-survivor	10.98±1.47	10.83±1.73	0.568
PDW	Total	16.20±0.87	16.33±0.64	0.116
	Survivor	16.24±0.61	16.32±0.65	0.314
	Non-survivor	16.01±1.54	16.40±0.59	0.236
PLCR	Total	41.15±10.78	42.07±11.75	0.357
	Survivor	40.52±10.22	42.03±11.66	0.180
	Non-survivor	43.70±12.73	42.25±12.41	0.524
PLT	Total	258.23±168.75	278.44±172.30	0.100
	Survivor	262.30±179.79	291.09±182.92	0.035
	Non-survivor	241.61±114.59	226.78±107.76	0.603
PCT	Total	2.61±1.50	2.87±1.43	0.004
	Survivor	2.54±1.58	2.96±1.48	0.002
	Non-survivor	2.40±1.10	2.50±1.17	0.779

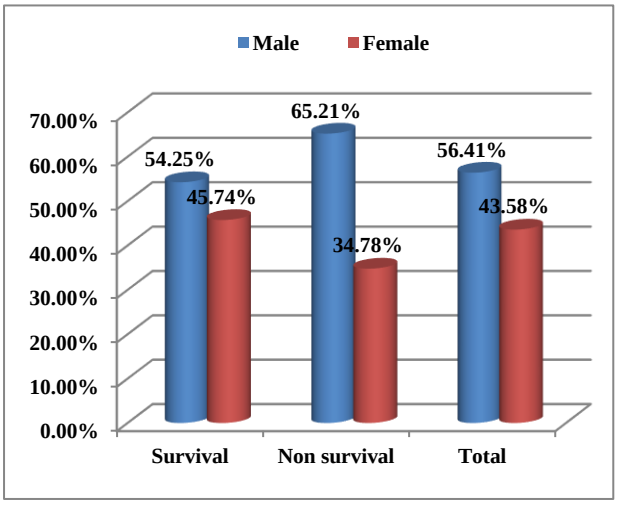

Figure 1: Sex wise distribution of survival (54.25% male and 45.74% female), non-survival (65.21% male and 34.78% female), and total (56.41% male and 43.58% female) patients with sepsis included in the study.

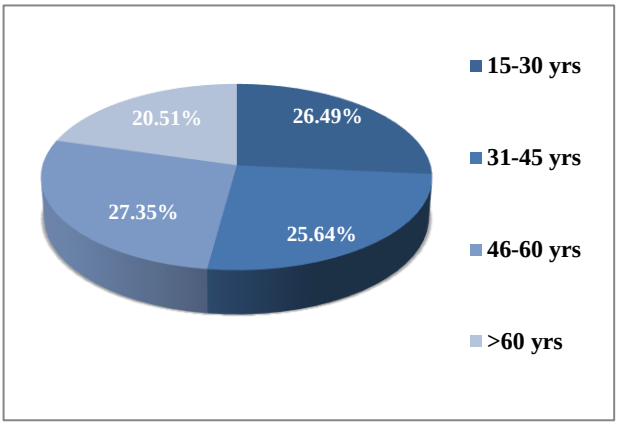

Figure 2: Age wise distribution of the total patients in the study.

This probably infers the occurrence of sepsis mostly in the older age group in this study. However, this might be a case selection bias and not necessarily has any inference on the severity of the illness. A western study reported a higher incidence of sepsis in patients aged above 57

years.[9] The mean age in an epidemiological study of sepsis in India was 54.9 years.[10] In a study conducted in Karnataka, India by Sudhir U et al, in 2011 highest number of patients were in the age group of 50 to 59 years.[11] In another study by Meynaar IA et al, mean age of patients with sepsis was 65 and those with SIRS were 62 years.[12]

The statistical analysis finding of NLCR suggested that there was an overall increase in NLCR in patients with sepsis as observed on day of admission (day 1) and seventh day (day 7) in all the three observation groups taken for study. This finding was consistent with study by Florence Riché et al, which showed that septic shock patients at risk of early death had a low NLCR at admission, although late death was associated with an increased NLCR during the first 5 days.[3] Another study by Liu X et al, showed Increased NLR levels were independently associated with unfavorable clinical prognosis in patients with sepsis. Further investigation is required to increase understanding of the pathophysiology of this relationship.[13]

An overall increase in the RDW SD values for all the three groups correlate with the findings made by Shaikh MA et al, which concluded that RDW levels measured on admission can be used as a prognostic marker in patients in severe sepsis and septic shock.[4]

However, there was no statistically significant difference in the MPV values on day 1 and day 7 but the overall mean and SD was higher in non-survivor group as compared to that of survivor group with sepsis. A study by Gao Y et al, (2014) showed that MPV in the non-survivor group was higher than that of the survivor group.[6]

The statistical analysis finding suggest that there is no significant change in PDW in patients with sepsis as observed on day of admission day 1 and seventh day (day 7) in all the three observation groups taken for study. These results were contradictory with the findings of a study by Guclu E et al, where MPV and PDW were significantly different between sepsis patients and control group ($P<0.05$). PDW was the unique significantly different parameter between survivors and non-survivors ($P=0.001$).[14]

The statistical analysis finding of PLT suggested that there was significant change in mean PLT only in survivor group patients with sepsis and not in total and non-survivor groups as observed on day of admission (day1) and seventh day (day7). A study by Guclu E et al, (2013) showed that platelet count in sepsis patients was lower than control group, but the difference was not significant.[14]

A poor prognostic implication was observed for PLCR with no significant statistical difference on day 1 and day 7 of admission for all the three groups whereas the PCT values showed significant P values only for total and survivor patients' groups. A study by Gao Y et al, in 2014 concluded that different change trends of platelet parameters can be seen between the non-survivors and survivors of septic shock patients. If PDW, PLCR and MPV show increased trend while PLT and PCT show decreased trend, a poor prognosis maybe indicated.[6]

CONCLUSION

Sepsis is a major cause of admissions to ICU and emergency wards in any tertiary care center with a significant mortality and morbidity. Though guidelines for management of these patients have been updated but still mortality rate remains high. Existing markers for prognosis and disease severity assessment scores are not always available at all centers. The prediction of outcome for patients with sepsis using easily available and reliable marker may facilitate more aggressive interventions made at appropriate time. Various hematological parameters have been found to be associated with outcome in patients with critical illness and sepsis in many previous studies, also it is routinely reported as part of complete blood count and widely available to physicians without addition of any extra cost for investigations purpose.

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REFERENCES

1. Bone RC, Balk RA, Cerra FB, Dellinger RP, Fein AM, Knaus WA, et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis. Chest. 1992;101(6):1644-55.
2. Dellinger RP, Levy MM, Carlet JM, Bion J, Parker MM, Jaeschke R, et al. Surviving sepsis campaign: international guidelines for management of severe sepsis and septic shock. Intensive Care Med. 2008;34(1):17-60.
3. Riché F, Gayat E, Barthélémy R, Le Dorze M, Matéo J, Payen D. Reversal of neutrophil-to-lymphocyte count ratio in early versus late death from septic shock. Crit Care. 2015;19(1):439.
4. Shaikh MA, Yadavalli DR. Red cell distribution width as a prognostic marker in severe sepsis and septic shock. Int J Adv Med. 2017;4(3):750.
5. Kim CH, Kim SJ, Lee MJ, Kwon YE, Kim YL, Park KS, et al. An increase in mean platelet volume

from baseline is associated with mortality in patients with severe sepsis or septic shock. PLoS One. 2015;10(3):e0119437.
6. Gao Y, Li Y, Yu X, Guo S, Ji X, Sun T, et al. The impact of various platelet indices as prognostic markers of septic shock. PLoS One. 2014;9(8):e103761.
7. Padkin A, Goldfrad C, Brady AR, Young D, Black N, Rowan K. Epidemiology of severe sepsis occurring in the first 24 hrs in intensive care units in England, wales, and Northern Ireland. Critical Care Med. 2003;31(9):2332-8.
8. Sinha M, Desai S, Mantri S, Kulkarni A. (2011). Procalcitonin as an adjunctive biomarker in sepsis. Indian J Anaesthesia. 2011;55(3):266.
9. Martin GS, Mannino DM, Eaton S, Moss M. The epidemiology of sepsis in the United States from 1979 through 2000. New England J Med. 2003;348(16):1546-54.
10. Todi S, Chatterjee S, Bhattacharyya M. Epidemiology of severe sepsis in India. Crit Care. 2007;11(2):P65.
11. Sudhir U, Venkatachalaiah RK, Kumar TA, Rao MY, Kempegowda P.Significance of serum procalcitonin in sepsis. Indian J Crit Care Med. 2011;15(1):1-5.
12. Meynaar IA, Droog W, Batstra M, Vreede R, Herbrink P. In critically ill patients, serum procalcitonin is more useful in differentiating between sepsis and SIRS than CRP, Il-6, or LBP. Crit Care Res Practice. 2011;2011.
13. Liu X, Shen Y, Wang H, Ge Q, Fei A, Pan S. Prognostic significance of neutrophil-to-lymphocyte ratio in patients with sepsis: a prospective observational study. Mediators Inflammation. 2016;2016.
14. Guclu E, Durmaz Y, Karabay O. Effect of severe sepsis on platelet count and their indices. Afr Health Sci. 2013;13(2):333-8.

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