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RESEARCH ARTICLE

COMPARISON OF RED CELL DISTRIBUTION WIDTH (RDW) AND APACHE II SCORE AS PROGNOSTIC MARKER AMONG PATIENTS OF SEPSIS AND SEPTIC SHOCK IN A TERTIARY CARE INSTITUTE, SOUTHERN RAJASTHAN.

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Abstract

Despite advancements, severe Sepsis and septic shock are increasing and contributing significantly to mortality. Acute Physiology and Chronic Health Evaluation (APACHE) II scoring is used as an index of illness severity and for outcome prediction. However, calculating it is cumbersome. Recent studies reported that Red Cell Distribution Width (RDW) is associated with prognosis in Critical Illness and as a part of Complete Blood Count, it is tested in all patients of sepsis. Hence, this study is being done to see correlation between RDW and sepsis.

Materials and methods: A hospital-based prospective observational study done for a year on 50 patients admitted with sepsis and septic shock in the intensive care units of RNT Medical College & MBGH, Udaipur after taking consent. The necessary details were taken in Proforma and data was analyzed in MS excel and the results were interpreted & significance was attributed to $P < 0.05$

Results: Out of 50 patients- 21 were non-survivors, 15(71.43%) were males & most of the patients in the age group of 41-60 years (47.62%) in non-survivors. Amongst survivors, 19 (65.52%) were males & most of the patients in the age group of 61-80 years (37.93%) Mean APACHE II score among non-survivors was 30.43 ± 6.14 and 16.14 ± 6.50 among survivors. Mean RDW among non-survivors was 16.09 ± 2.24 and among survivors was 14.45 ± 1.45 .

Conclusion: There was a statistically significant positive correlation between APACHE II & RDW among survivors and non-survivors. In developing countries like India, RDW levels measured on admission can be used as a prognostic marker in severe sepsis and septic shock.

Introduction:-

Severe Sepsis and septic shock are increasing in incidence and contributing significantly to mortality.^{1,2} The incidence rate of sepsis has increased at a rate of 8.7% per year.¹ Despite advancements, the mortality rate is still between 17.9% and 28.6%.³ The prediction of outcome for patients with sepsis may facilitate more aggressive interventions. The degree of severity is, most often, quantified by the Acute Physiology and Chronic Health Evaluation (APACHE) II score, which can predict the severity and outcome of multiple organ failure.⁴ It is probably the best-known and most widely used score. It includes 34 individual variables, a chronic health evaluation, and the two combined to produce the severity score. The APACHE II score is the modification of the original APACHE scoring proposed by Knaus WA, et al.⁵ However, calculating APACHE II Score is cumbersome.⁶ It would be advantageous to identify a biomarker that would be associated with the degree of severity in patients with sepsis.

The red cell distribution width (RDW) is the coefficient of variation in red blood cell (RBC) volume and is representation of the RBC size heterogeneity of an individual patient.⁷ RDW is elevated by increased red cell destruction, nutritional deficiencies and blood transfusions.⁸ Recent studies have reported that Red Cell Distribution Width (RDW) is associated with prognosis in Critical Illness, Heart failure, Acute Myocardial Infarction, Pulmonary Embolism, Pneumonia and Cardiac Arrest.⁹⁻¹⁴

The positive gain from the above study may be of economic benefit to the patient and as well as to the system in terms of expenditure and time. The ultimate benefit could be in terms of improved outcomes because of earlier and more accurate assessment of the septic threat, leading to earlier prediction of deterioration, quicker response, more effective and timely therapeutic strategies. RDW as a part of Complete Blood Count (CBC) is tested in all patients of sepsis. Hence, this study is being done to see the correlation between RDW and sepsis.

Aims & Objectives:-

1. To study the role of Red cell distribution width(RDW) as a prognostic marker among survivors and non-survivors in patients of severe sepsis and septic shock
2. To compare APACHE II and RDW among survivors and non-survivors in patients of sepsis and septic shock.

Methodology:-

This was a hospital based prospective observational study done for a period of 1 year (August 2017- July 2018) in RNT Medical college and attached MB Government Hospital, Udaipur, Rajasthan over 50 patients who fulfilled selection criteria.

Inclusion criteria:

Patients admitted to Intensive Care Units (ICU) who met the criteria of Severe Sepsis and Septic Shock & age >18years

Exclusion criteria:

1. Bleeding >10% blood volume.
2. Blood product Transfusion in the previous week of admission.
3. Recent Chemotherapy.
4. Previous History of diseases primarily affecting Red Blood Cells.
5. Use of drugs known to change Morphology and Theology of Red Blood Cells.
6. Pregnancy.

Data collection:

After taking the informed consent, 50 patients of sepsis & septic shock were assessed, vital parameters, age, past history and GCS were recorded and blood samples for Complete Blood Count including RDW and ABG were sent. Other tests such as liver function tests, renal function tests, serum electrolytes, electrocardiography, chest X-ray and USG abdomen were done. The following data and investigations were entered in the clinical Proforma. Study subjects were divided into two groups of non-survivors and survivors. Clinical parameters, Laboratory investigations, APACHE II score and RDW were compared among the two groups.

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Data Analysis:

All the data was compiled tabulated and analysed for variation for mean and correlation by SPSS 20.0 Statistical package program. The quantitative data of the groups was compared using ANOVA (Analysis of Variance) and the qualitative data was compared using Chi-square test. P value < 0.05 was considered significant. The data obtained was coded and entered in Microsoft Excel spreadsheet. The categorical data was expressed as rates, ratios and percentages and comparison was done.

Ethical clearance:

This study was approved from the Ethical and Research Committee. RNT Medical College and attached group of hospitals, Udaipur (Rajasthan).

INFORMED CONSENT: The patients fulfilling selection criteria were informed in detail about the risks and benefits of the procedure and a written informed consent was obtained before enrolment.

Results:-

A total number of 50 patients of sepsis and septic shock were included in the study out of which 21 were non-survivors and 29 were survivors. Their vitals, laboratory investigations along with RDW and APACHE II were calculated and compared between the two groups.

Most of the patients were in the age group of 41-60 years in non-survivors (47.62%) and 61-80 years in survivors (37.93%). Among non-survivors 15(71.43%) were males and 6(28.57%) were females, while in survivors 19(65.52%) were males and 10(24.48%) were females. Fever was the most common presenting symptom in non-survivors (100%) compared to 75.86% survivors who came with fever. In our study Diabetes mellitus was the most common co morbidity among non-survivors (57.14%) and survivors (24.13%). Dialysis Dependency was also common among non-survivors (23.80%).

Baseline variables showed that Mean arterial pressure was lower among non-survivors (59.52 ± 5.21) as compared to survivors (92.86 ± 12.82) with a p value of 0.0392 (**Table 1**).

Table 1:-showing Baseline variables compared with Outcome

Baseline Variables	Outcome		Mean $\pm$ SD	P value
	Non-survivors	Survivors		
Age (years)	54.09 $\pm$ 16.50	50.00 $\pm$ 16.68	51.72 $\pm$ 16.77	0.001
Temperature (°F)	101.77 $\pm$ 1.28	100.47 $\pm$ 1.16	101.02 $\pm$ 1.37	0.992
Respiratory rate (breaths/min)	28.90 $\pm$ 4.97	22.70 $\pm$ 3.97	25.26 $\pm$ 5.35	0.819
Heart rate (beats/min)	119.57 $\pm$ 8.07	103.38 $\pm$ 9.86	110.18 $\pm$ 12.14	0.920
MAP (mmHg)	59.52 $\pm$ 5.21	92.86 $\pm$ 12.82	78.86 $\pm$ 19.43	0.039
SpO ₂ (%)	91.09 $\pm$ 7.18	94.34 $\pm$ 2.96	92.98 $\pm$ 5.41	0.877

Laboratory findings: Mean Total leucocyte count (TLC) was 26134.76 $\pm$ 6967.05 cells cu/mm in non-survivors and 14572.41 $\pm$ 9143.17 cells cu/mm in survivors with p value 0.001. Mean PaO₂ was 157.98 $\pm$ 116.33 mmHg among non-survivors and 382.39 $\pm$ 112.77 mmHg among survivors with p value = 0.001. Mean pH was 7.32 $\pm$ 0.16 in non-survivors and 7.35 $\pm$ 0.11 in survivors.

To calculate APACHE 2 score, following parameters were taken. Mean serum creatinine was 3.97 $\pm$ 3.11 mg/dl in non-survivors and 3.28 $\pm$ 3.16 mg/dl in survivors. Mean serum sodium among non-survivors was 129.30 $\pm$ 9.49 mEq/dl and 133.55 $\pm$ 5.47 mEq/dl among survivors. Mean potassium levels among non-survivors were 3.58 $\pm$ 1.08 mEq/dl and among survivors were 3.72 $\pm$ 0.62 mEq/dl & Mean GCS was 9.14 $\pm$ 3.46 in non-survivors and 14.55 $\pm$ 1.33 in survivors with p value of 0.0232.

Mean APACHE II score among non-survivors 30.43 $\pm$ 6.14 and 16.14 $\pm$ 6.50 among survivors with a p value of 0.0011 (**Table 2**)

Table 2:-showing APACHE II Scores among Non-Survivors & Survivors of Sepsis

APACHE II score	Non-survivors (n=21)	Survivors (n=29)	P value
<15	0	12	0.0011

15-24	4	14	
≥ 25	17	3	
Mean ± SD	30.43±6.14	16.14±6.50	

Mean RDW among non-survivors was 16.09±2.24% and among survivors was 14.45±1.45% with a p value of 0.0225.(Table 3)

Table 3:- showing comparison of RDW with the Outcome

RDW (%)	Non-survivors (n=21)	Survivors (n=29)	P value
≤ 14.5	1	18	0.0225
14.6-17.3	18	9	
>17.3	2	2	
Mean ± SD	16.09±2.24	14.45±1.45	

The APACHE II and RDW were significantly higher in non-survivors than survivors with significant p value (Figure 1)

Figure 1:- showing Comparison of APACHE II Score & Serum RDW according to Outcome of sepsis

Discussions:-

Sepsis and septic shock are one of the leading causes of death worldwide. Early detection and prompt administration of antibiotics has been shown to reduce mortality and morbidity in patients with sepsis. Hence, various markers have been evaluated for earlier diagnosis of sepsis. There are many other markers of sepsis which are being evaluated for its diagnosis among which RDW is emerging as a promising marker.

In our study, the mean age group was 51.72 ± 16.72 years. But the study done by **Jo YH et al.**¹⁵, the mean age was 70.0 ± 13.4 years.

Males were predominant in our study (68%) is in accordance with study done by **Zhongzheng hang et al**¹⁶(65.4%).

Diabetes Mellitus (57.14%) and Dialysis dependency (23.80%) were the two most common co-morbidities in our study.

According to **Henry E. Wang et al**¹⁷ the most common co-morbidities were chronic lung disease and peripheral artery disease. As India has the maximum growing population of diabetes and its complications in the world, in our study the most common co-morbidity was diabetes and dialysis dependency.

In our study the mean APACHE II score among non-survivors was 30.43±6.14 and was 16.14±6.50 among survivors and was statistically significant with a p value of 0.0011.

This is in accordance with **Boonen et al**¹⁸ who studied 100 patients with abdominal sepsis. According to their study APACHE II score in non-survivors (19.5 ±5.9) was significantly higher than survivors (11.7 ±6.4).

A study done by **NA Mahmood et al**¹⁹ was also associated with increased mortality in patients of sepsis with n APACHE II score of ≥15 as compared to the patients with a score <15.

Mean RDW among non-survivors was 16.09 ± 2.24 and 14.45 ± 1.45 among survivors which was statistically significant (p value=0.0225). This is in accordance with Jo YH et al¹⁵ where Red cell distribution width was significantly higher in non-survivors than in survivors, and the corresponding mortality of patients with an RDW of 14% or less, 14.1% to 15.7%, and 15.8% or greater was 13.1%, 30.1%, and 44.9%, respectively.

Edal Braun et al²⁰ studied patients of community acquired pneumonia and found out that higher RDW (>16) at the time of admission was an independent risk factor for mortality and severe morbidity and was unrelated with hemoglobin, WBC count and age.

Conclusion: -

There was a statistically significant correlation between APACHE II among survivors and non-survivors. RDW was statistically significant among survivors and non-survivors. There was a significant positive correlation between RDW and APACHE II score.

In developing countries like India, RDW levels measured on admission can be used as a prognostic marker in severe sepsis and septic shock.

Limitations: -

As our study included only 50 patients of sepsis and septic shock, a study with a greater number of patients is required to assess the utility and efficiency of RDW as a prognostic marker in sepsis and septic shock.

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