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Comparison of RDW with APACHE II in Patients of Severe Sepsis for Prognostication

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Abstract

Sepsis and severe sepsis are a common cause of admission of a patient in intensive care unit and are commonly associated with high mortality rates. RDW is calculated by blood analysers and represents the range of variation in the size of red blood cells in blood. APACHE II (Acute Physiology, Age, Chronic Health Evaluation II) score is a commonly used prognostic indicator which involves 12 variables – both clinical and laboratory. Our study is a single-centre prospective observational study. This study is conducted at People's Hospital of Peoples College of Medical Sciences and Research Centre. Data collection was done from December 2017 to August 2019. All patients received standard medical therapy as per their clinical condition. These patients were then followed-up after 30 days telephonically to check for mortality. The inclusion criterion was severe sepsis patients admitted in ICU or casualty (as defined by the SIRS criteria). Among 32 (54.23%) patients with a score of RDW + APACHEII OF > 29.5, 19 (32.20%) patients did not survive and of the rest 27 (45.76%) with a score of < 29.5, 7 (11.86%) did not survive. From the p value of < 0.001, it can be concluded that there is significant association of higher RDW + APACHE II with mortality.

Introduction

Sepsis, as defined in 2016 by the Sepsis Definitions Task Force, is a life-threatening organ dysfunction caused by a dysregulated host response to infection[5].

Sepsis was earlier defined in the 1991 Consensus Conference, and which largely remained unchanged for about 2 decades by the Severe Inflammatory Response Syndrome (SIRS) criteria[6,7]:-

SIRS is considered to be present when patients have more than one of the following clinical findings:

- Body temperature higher than 38° C or lower than 36° C.
- Heart rate higher than 90/min.
- Hyperventilation evidenced by respiratory rate higher than 20/min or PaCO2 lower than 32 mmHg.
- White blood cell count higher than 12,000 cells/µl or lower than 4,000/µl[6].

Sepsis and severe sepsis are a common cause of admission of a patient to an intensive care unit, and are commonly associated with high mortality rates.

Red cell distribution width (RDW) is a measurement derived from the RBC distribution curves generated on the automated haematology analyser, and is an indicator of variation in RBC size within a blood sample (anisocytosis). RDW is a very commonly available and inexpensive measurement which is a part of all Complete Blood Picture reports.

APACHE II uses a point score based upon initial values of 12 routine physiologic measurements, age, and previous health status to provide a general measure of severity of disease. An increasing score (range 0 to 71) was closely correlated with the subsequent risk of hospital death for 5,815 intensive care admissions from 13 hospitals in a study by Knaus *et al*[2].

Material and methods

Our study is a single-centre prospective observational study. This study was conducted at People's Hospital of Peoples College of Medical Sciences and Research Centre.

Of all the patients who got admitted during the study period in the People's Hospital ICU or casualty, and diagnosed as sepsis clinically, and on the basis of initial investigations as per the Severe Inflammatory Response Syndrome criteria (when patients have more than one of the following clinical findings: body temperature higher than 38° C or lower than 36° C, heart rate higher than 90/min, hyperventilation evidenced by respiratory rate higher than 20/min or PaCO2 lower than 32 mmHg, white blood cell count higher than 12,000 cells/µl or lower than 4,000/µl with a suspicion of infection) were considered as potential participants of the study. On admission of patients suspected to have sepsis, their demographic profile and vitals were noted. The investigations needed for the APACHE 2 score calculations were sent as these investigations anyway are part of baseline investigations needed in a patient of sepsis. The patients identified as *severe sepsis* on the basis of reports

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and clinical data which suggests sepsis with one or more organ failure[7] and after obtaining consent either from the patient or relative of the patient are included in our study.

Inclusion criteria

Severe sepsis patients admitted in ICU or casualty (as defined by the SIRS criteria).

Exclusion criteria

1. Pregnant females.
2. History of blood transfusion in the last one week.
3. Known haematological disorders (leukaemia, myelodysplastic syndrome, neoplastic metastsis to bone marrow).
4. Recent chemotherapy, or immunosuppression, or solid organ transplants.
5. Post-splenectomy.
6. Drugs known to influence morphology of red blood cells.
7. The patients who could not have been reached via telephone call and could not be contacted after one month period were not included in the study.

Results

Table I: Distribution of survivors and non-survivors among the 3 RDW groups.

	Prognosis of subjects		Total
	Non-survivors	survivors	
RDW - CV			
< 14.5 (group 1)	10	17	27
14.6 - 17.3 (group 2)	12	12	24
> 17.4 (group 3)	4	4	8
Total	26	33	59

Chi square value is 0.9 p value 0.6.

Table II: Association of APACHEII + RDW value with mortality.

Parameters	Result	N	Mean	Std deviation	P value
RDW CV	Survivors	33	14.712	1.8530	
	Non-survivors	26	14.962	2.2239	0.64
APACHE II	Survivors	33	13.152	4.1164	
RDW + APACHEII	**Non-survivors**		**Survivors**		**Marginal row table**
< 29.5	7		20		27
> 29.5	19		13		32
Marginal row column	26		33		59

Chi square statistic is 6.6473. The p value 0.001.

Table III: Comparison of RDW-CV and APACHEII among survivors and non-survivors.

Parameters	RESULT	N	Mean	Std. deviation	P value
RDW CV	Survivors	33	14.712	1.8530	
	Non-Survivors	26	14.962	2.2239	0.64
APACHE II	Survivors	33	13.152	4.1164	
	Non-survivors	26	20.154	7.6089	0.001

The total number of subjects who were identified as severe sepsis and who participated in our study were 62, of which 3 subjects were lost to follow-up. There are 59 patients who were identified as severely septic and in whom all the data were available. The data entry was done in MS excel sheet. Data analysis was done in SPSS version 24 (IBM INC. New York, USA).

We calculated the mean and standard deviation for continuous data. We divided the groups in RDW as:

a) < 14.5 (Group 1)

b) 14.5 - 17.3 (Group 2)

c) > 17.3 (Group 3)

(as per a previous study by Jandial published in the *Journal of Critical Care*).

The continuous and discrete data were analysed between these groups. Student T test was used for analysing normally distributed continuous variables. Chi-square test was used for discrete data.

RDW values were added to APACHE II values and the patients segregated as above or below 29.5. The figure of 29.5 was arrived on the basis of addition of the upper normal limit of RDW (14.5) and a baseline value of 15 for APACHE II, which has been considered in various studies involving APACHE II to be a threshold of significance to study poor outcomes.

Aamong 32 (54.23%) patients with a score of RDW + APACHE II of > 29.5, 19 (32.20%) patients did not survive and of the rest 27 (45.76%) with a score of < 29.5, 7 (11.86%) did not survive. From the p value of < 0.001, it can be concluded that there is significant association of higher RDW + APACHE II with mortality.

Table I shows that of the 26 (44.06%) non survivors, 10 (16.94%) are in group 1, 12 (20.33%) in group 2, and 4 (6.77%) in group 3. While among the 33 (55.93%) survivors, 17 (28.81%) are in group 1, 12 (20.33%) in group 2, and 4 (6.77%) in group 3.

Table III shows that there were 33 (55.9%) survivors and 26 (44.1%) non-survivors. APACHE II in survivors had a mean value of 13.152 with a standard deviation of 4.11; and among non survivors with a mean value of 20.154, with a standard

deviation of 7.60, with a p value of < 0.001 was found to be a significant independent predictor of mortality. RDW in survivors had a mean value of 14.712 with a standard deviation of 1.85 and among non survivors a mean value of 14.962 with a standard deviation of 2.23 showed no independent significance in estimating one-month mortality.

Conclusion

The study confirms the value of APACHE II as a predictor of mortality and also identifies the value of RDW on addition to APACHE II as a predictor of the same. The study also identifies that RDW fails to independently prognosticate regarding mortality in patients of severe sepsis.

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