RESEARCH ARTICLE

THE VALUE OF NEUTROPHIL TO LYMPHOCYTE RATIO, PLATELET COUNT AND RED CELL DISTRIBUTION WIDTH TO PLATELET RATIO AS PROGNOSTIC MARKERS IN BURN PATIENTS

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ABSTRACT: **Background**: The aim of the study was to find a relationship between neutrophil to lymphocyte ratio (NLR), platelet count and red cell distribution width to platelet ratio (RPR) and mortality in burn patients and whether these parameters can be used to predict the outcome in these patients. **Material and methods**: The retrospective study was performed on 242 patients admitted in the department of burns and plastics between February 2019 and December 2019. The study population was further divided into two groups i.e the discharge group (group 1) and the mortality group (group2). Demographic information in both groups such as age, gender, burn scores, neutrophil counts, lymphocyte counts, platelet counts and RDW during admission to the hospital was recorded. NLR and RPR were calculated using the patient's complete blood count (CBC). **Results**: NLR was higher in the mortality group (14.44±6.95) in comparison to the discharge group (7.23±3.25). RPR values were also noticeably higher in the mortality group (0.312±0.124) when compared to the discharge group (0.067±0.029). Whereas platelet count was seen to be lower in the mortality group (92.24±74.01) as compared to the discharge group (162.84±82.52). Each of the above results were statistically significant (p=0.00). These results correlated with a higher R-BAUX score that was seen in the mortality group. **Conclusion**: NLR, RPR and platelet count can be effectively used as prognostic markers to monitor the progression in burn patients.

KEYWORD: Neutrophil to lymphocyte ratio, platelet count, red cell distribution width to platelet ratio, burn, complete blood count.

INTRODUCTION:

Burn is a major cause of aggressive acute traumatic injury and is a major cause of mortality and morbidity worldwide[1]. An estimated 180000 deaths occur every year due to various burn injuries. Burns are among a leading cause for Disability-adjusted life year (DALY) lost in low and middle income countries[2]. In countries like India around 70 lakh people suffer from burn injuries with 1.4 lakh deaths and 2.4 lakh people suffer from various disability due to it[3].A variety of clinical and

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laboratory markers have been traditionally used to determine the prognosis of burn patients. This includes burn injury severity scores, RYAN score, R-BAUX score and inflammatory markers like erythrocyte sedimentation rate (ESR), C- reactive protein (CRP) and procalcitonin(PCT)[4-6]. Serge Baux developed a simple score predicting mortality after acute burn injury. This score proved to be a relatively easy method to predict mortality in burn patients. Since the development of the Baux score in 1961, mortality rates reduced drastically due to timely intervention and active fluid resuscitation. The revised BAUX score was developed by osler et al. and is calculated as the sum of age and total body surface area (TBS) burned plus 17 points for inhalation injury; so in case of inhalation injury, the revised BAUX score becomes 17 points higher than the original BAUX score[l7].

Both neutrophil to lymphocyte ratio (NLR) and red cell distribution width (RDW) to platelet ratio (RPR) are readily available biomarkers which can be calculated from a simple complete blood count (CBC).

NLR has been used as an independent prognostic marker for various diseases like urothelial carcinoma[8], colorectal carcinoma[9], squamous cell carcinoma[10] and patients which cardiovascular diseases[11] and patients with sepsis[12]. Similarly RPR is used to predict fibrosis and cirrhosis in patients with hepatitis B infection[13]. It has also been used as a prognostic marker in acute pancreatitis[14] and myocardial infarction with ST elevation[15].

Our aim was to find a meaningful relationship between NLR, RPR and platelet count and mortality in burn patients and whether these parameters can be used to predict the outcome in these patients.

After an extensive search we found only a handful of studies that has studied the correlation of RDW, platelet count, RPR and NLR with the severity of burn injury and as a predictor for the outcome in these patients.

MATERIALS AND METHODS:

The retrospective study was performed on 242 patients admitted in the department of burns and plastics between February 2019 and December 2019. Patient with any known pre-existing heart disease, kidney disease, or any other conditions that

is known to alter RDW or platelet count was excluded from the study. The study population was further divided into two groups i.e the discharge group (group 1) and the mortality group (group2). Demographic information in the both groups such as age, gender, burn scores, neutrophil counts, lymphocyte counts, platelet counts and RDW during admission to the hospital was recorded. Moreover a through clinical examination of all patients in each group was done and R-BAUX score was calculated. Informed consent was obtained and the benefits and risks of participating in the study were explained to the patients. NLR and RPR were calculated from the patient's CBC. NLR is calculated by dividing the number of neutrophils by the number of lymphocytes (n=0.78-3.53). Similarly RPR is calculated from the following equation, $RPR = RDW \times 100 / PLT \ (10^9/L)$. Other parameters like neutrophil count, lymphocyte, platelet count, RDW etc were noted from the patient's CBC.

Statistical analysis

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 20.0 (IBM, Chicago, IL, USA). The Mann Whitney-U test was used for numerical values which did not have normal distribution. Multivariate logistic regression analysis was used to study various independent factors. The results were evaluated in a 95% confidence interval and a p <0.05 was considered significant.

RESULTS:

A total of 242 patients were included in the study. Out of the 242 cases, 152 (62.8%) were male and 90(37.2%) were female. The study population was further divided into two groups i.e the discharge group (group 1, n=194) and the mortality group (group2, n=48). The mean age of group 1 was 46.82 years whereas the mean age of group 2 who was 34.38 years.

R-BAUX score was calculated for the individual groups. It was seen that R-BAUX score was much higher for group 1(86.23±21.86) in comparison to group 2 (45.14±16.44).

In our study we found that NLR was significantly higher in the mortality group (14.44±6.95) in

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comparison to the discharge group (7.23±3.25) (p=0.00).

Moreover platelet count was seen to be significantly lower in the mortality group (92.24±74.01) as compared to the discharge group (162.84±82.52) (p=0.00). The RPR values were noticeably higher in the mortality group (0.312±0.124) as compared to the discharge group (0.067±0.029) (p=0.00). (**Table 1**).

Table 1- Demographic details and blood count of group

	Mortality group (n=48)	Discharge group(n=194)
Age	46.82	34.38
Sex(m/f)	25/23	127/67
R-BAUX score	86.23±21.86	45.14±16.44
Neutrophil to lymphocyte ratio (NLR)	14.44±6.95	7.23±3.25
Platelet count	92.24±74.01	162.84±82.52
RDW to platelet ratio (RPR)	0.312±0.124	0.067±0.029
Inhalation injury	19(39.6%)	33(17.0%)
1st degree burn/2nd degree burn/3rd degree burn	0/19(39.58%)/29(60.41%)	0/156(80.41%)/38(19.59%)

DISCUSSION:

The routine CBC provides a number of useful parameters that can be used in determining the prognosis of burn patients. Burn causes activation of a complex set of events leading to release of inflammatory mediators that causes pathological changes in the body[16]. Platelets play an important role in severe hemostatic disorder and in the disordered immune response in severe burn patients. There is release of a variety of inflammatory mediators that express pro-inflammatory response and interact with leukocytes and endothelial cells to induce acute and chronic immune response[17].

The main inflammatory cells responsible for promoting burn injury are neutrophils, mast cells, monocytes and macrophages whose activities are mediated by a number of cytokines and growth factors which directs the progression through the healing cascade[18].

Burn wounds are characterized by persistent high number of neutrophils however studies have shown that following burn injury there is reduced directional migration speed, impaired phagocytic and bactericidal function[19]. Neutrophils sequester in organs due to a systemic inflammatory response to burn injury and leads to the formation of oxygen free radicals. These oxygen free radicals can cause tissue damage by increasing the activity of xanthine oxidase. It has also been observed that there is suppression of delayed type of hypersensitivity reaction and reduced lymphocyte count in peripheral blood[20].

NLR is a simple and readily available parameter which can be used in a variety of diseases as a potent prognostic marker. It has been used in various diseases like urothelial cancer[8], colorectal cancer[9], squamous cell carcinoma[10], and other diseases like in cardiovascular diseases[11], autoimmune diseases[21] and sepsis[12].

Our data showed significantly higher levels of NLR in the critically ill set of patients in the mortality group of our study in comparison to the discharge group. This is in line with previous studies done by Ciftci et al[22] and Julia Fuss et al. Julia fuss et al[23] studied its role in patients with burn with subsequent sepsis and bacteremia. They also compared the usefulness of NLR when compared to other parameters traditionally used in burn induced sepsis. Their study revealed that NLR and PCT were more accurate markers in differentiating sepsis from SIRS (systemic inflammatory response syndrome) in comparison to markers like ESR, CRP, or WBC count[23].

We further tried to establish the role of RPR as a prognostic tool in burn patients. Our records showed that RPR was again significantly higher in the mortality group of our study when compared to the discharge group. Moreover platelet count was also found to be lower in the mortality group. On extended search of literature we could find only one study done by Li Qui et al[24] that studied its role in prognosis of burn patients. Li Qui et al's study established that a higher RPR value is seen in patients with severe burn and such patients have a poorer prognosis. Moreover in their study platelet count was consistently low in the patients with

severe burn. They established the fact that patients with severe burns show a progressive increase in the RDW values and a reduction in the platelets as the condition progresses.

Dokter et al[7] studied the accuracy of the R-BAUX score to predict mortality in acute burn patients. Their study showed that the R-BAUX model has a high sensitivity and specificity to predict the outcome of patients with acute burn injury. Our study showed that patients with higher NLR and RPR value and a low platelet count were in the mortality group and had a persistently higher R-BAUX score. Thus, this clearly tells us that both RPR and NLR as well as platelet count can be effectively used as prognostic markers to monitor the progression in burn patients.

The study had a number of limitations. The smaller sample size and the failure to exclude certain factors like presence of any underlying infection can hamper the overall values. Moreover, a study with a larger sample size will be required to quantify and establish cut-offs of various parameters used in the study.

CONCLUSION:

NLR and RPR were seen to be increased in the mortality group. These parameters can be used as novel parameters to monitor the progression in patients with severe burns and predict mortality. Aggressive intravenous fluid resuscitation and timely surgical management can be instituted which can be benefiting to these patients.

Ethics
The above study has been conducted after clearance from the institutional ethical committe.

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