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Prognostic Test of Red Blood Cell Distribution Width Ratio with Platelets as a Predictor of Mortality in Burn Patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia

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A B S T R A C T

Introduction: Burns is a traumatic condition with a very high mortality rate. In an effort to prevent greater mortality in burn conditions, a predictor is needed to optimize the prediction of death in burn patients. This study aimed to determine the efficacy of red blood cell distribution width ratio (RDW) to platelets (PLT) as a predictor of mortality in burn patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. **Methods:** This study was a retrospective cohort analytic observational study. A total of 51 research subjects participated in this study. Observation of clinical data and sociodemographic and laboratory evaluations were carried out. Data analysis was carried out with SPSS in univariate, bivariate, and diagnostic tests. **Results:** The RPR diagnostic test on observation ≥ 7 days is more sensitive and specific than that on observation ≥ 3 days. This study shows that both observations ≥ 3 days and observations ≥ 7 days show similarity, where the RPR value is much higher in cases of mortality than in cases of alive. **Conclusion:** RPR value ≥ 7 days has prognostic value with better sensitivity and specificity in predicting mortality in burn patients.

1. Introduction

Burns is a traumatic condition with a very high mortality rate. Several studies show that in Southeast Asia, burns have a mortality rate of around 11.6 deaths per 100,000 population. These data are not much different from a study conducted in Indonesia, which found that burns caused death by 25.8%. These studies reinforce the fact that burns are a serious traumatic condition that requires attention and appropriate management to prevent increased mortality.[1-6]

In an effort to prevent greater mortality in burn conditions, a predictor is needed to optimize the prediction of death in burn patients. Several theories state that inflammation is a pathophysiological condition that underlies mortality in burns. Red cell distribution width (RDW), platelet (PLT), and the ratio of RDW to PLT (RPR) values are predictors that are believed to be useful in predicting mortality in burn patients. Several studies demonstrated the predictor efficacy of RPR in predicting mortality in burn patients. The results of other studies show results that contradict the results of previous studies regarding the efficacy of RPR as a predictor of mortality in burn patients. The inconsistency of study results regarding the efficacy of RDR encourages the need for other studies to strengthen the evidence based on the efficacy of RDR as a predictor of mortality in burn

patients.[7-12] This study aimed to determine the efficacy of the RDW to PLT (RPR) ratio as a predictor of mortality in burn patients at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia.

2. Methods

This study was an observational study with a retrospective cohort approach and used secondary data sourced from the medical records of the medical record installation of Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. A total of 51 research subjects participated in this study. The research subjects met the inclusion criteria in the form of patients aged over 18 years who had been diagnosed with burns > 20 percent who were treated at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia, 1 January 2019 – 31 December 2022, and the subjects had complete medical records. This study was approved by the medical and health research ethics committee at Dr. Mohammad Hoesin General Hospital, Palembang, Indonesia. (Number: LB.02.03/XVII.5.11/ETIK/03/2023).

This study observed clinical, laboratory, and sociodemographic data of burn patients. Data collected included demographic data (age, gender), burn area, cause of burn injury, length of stay, initial laboratory, and mortality status. Data analysis using data program software statistical package for the social science (SPSS) version 25. Univariate descriptive analysis is used to describe variables in the form of the mean or mean if the data distribution is normal, the median and IQR (interquartile range) if the data distribution is not normal, standard deviation (SD), and frequency distribution. Bivariate analysis with independent T-test. The RPR variable in the form of numerical data will be analyzed using the ROC curve to find out the cut-off, then used as a nominal variable. Variables will then be analyzed bivariate and using a significance value of $p \leq 0.05$. The probability of death in a patient with major burns is determined by relative risk (RR) and confidence interval (CI). The accuracy value will be sought by calculating the sensitivity, specificity, positive predictive value (NR (+)), and negative predictive value (NR (-)), the value false positive and false negative.

3. Results

Table 1 shows the baseline characteristics of the research subjects. The majority of research subjects were males, with the cause of the majority of burns being fire. The majority of burns are of the mixed type with superficial-mid dermal depth. A total of 18 subjects died, with an average hospitalization time of 17.5 days and an average burn area of 73.05%. Subjects who died showed a higher RDR value than subjects who were alive, both on the third and seventh day of observation.

4. Discussion

This study shows that the cut-off point of the RPR value ≥ 7 days is 0.072, so from these results, the number of patients who died with an RPR value > 0.072 was 16 people, and patients who lived with an RPR value > 0.072 were 4 people. There were 2 patients who died with an RPR value < 0.072 and 29 patients who lived with an RPR value < 0.072. From these results, the sensitivity is 88.9 %, and the specificity is 87.9 %. As for the positive predictive value, it is 80%, and the negative predictive value is 93.54 %, which means that if the RPR value ≥ 7 days for a burn patient is > 0.072, then the probability of the patient not to survive or dying is 80%, whereas if the RPR value ≥ 7 days for a burn patient is <0.072, then the probability for this patient to survive is 93.54 %. In addition, the table obtained values of false positive by 12.1 % and false negative by 11.1 %. This study also obtained a value of the relative risk is 12.5, which means that burn patients with an RPR > 0.072 (at ≥ 7 days) have 12.5 times the risk of dying compared to burn patients with an RPR < 0.072.

Table 1. Baseline characteristics of research subjects.

Variable	Alive (n = 33)	Death (n = 18)	Total
Gender			
Male	28	12	40
Female	5	6	11
Causes of burns			
Hot water	2	1	3
Fire	28	17	45
Chemical	1	0	1
Low-voltage electricity	2	0	2
Burn depth			
Non-mix type			
Epidermal	0	0	
Superficial dermal	0	0	
Mid dermal	0	0	2
Deep dermal	1	0	
Full thickness	1	0	
Mix type			
Superficial-mid dermal	12	2	
Superficial-deep dermal	11	9	
Superficial-full thickness	1	0	49
Mid-deep dermal	4	4	
Mid dermal – full thickness	1	1	
Deep dermal – full thickness	2	2	
Variable	**$\bar{x}$ + SD**	**Median (min-max)**	***p-value**
Age (years)			0,001
Alive (n = 33)	33.67 ± 13,223	33,0 (18 – 60)	
Death (n = 18)	39,89 ± 18,413	33 (17 – 68)	
Length of treatment (days)			0,000
Alive (n = 33)	25.21 ± 19,314	20 (7 - 90)	
Death (n = 18)	17,5 ± 22.485	10 (7 - 91)	
Burn area (%)			0,001
Alive (n = 33)	42,40 ± 20,38	36,0 (20 - 90)	
Death (n = 18)	73,05 ± 15.71	76 (39 - 90)	
Variable	**$\bar{x}$ + SD**	**Median (min-max)**	***p-value**
≤ 3 days			
RDW (%)			0,001
Alive (n = 33)	13,736 ± 1,595	13,3 (11,3-20,1)	
Death (n = 18)	14,467 ± 1,552	14,35 (11,7-17,1)	
PLT (10^6/mL)			0,000
Alive (n = 33)	289,36 ± 162,39	252,00 (52-858)	
Death (n = 18)	211,67 ± 133,73	182 (67 – 623)	
RPR			0,000
Alive (n = 33)	0,0614 ± 0,0410	0,051 (0,019-0,25)	
Death (n = 18)	0,0948 ± 0,0625	0,080 (0,026 – 0,255)	
≥ 7 days			
RDW (%)			0,001
Alive (n = 33)	14,073 ± 1,702	13,7 (11,9-21,1)	
Death (n = 18)	15,144 ± 1,040	15,35 (13,0-16,8)	
PLT (10^6/mL)			0,006
Alive (n = 33)	362,15 ± 171,38	342,00 (129-893)	
Death (n = 18)	114,61 ± 158,24	62,0 (6-626)	
RPR			0,000
Alive (n = 33)	0.0468 ± 0,0219	0,041 (0,015 - 0,1)	
Death (n = 18)	0,380 ± 0,557	0,245 (0.023 – 2,53)	

*T-test Independent, p<0,05.

Table 2 shows the RPR diagnostic test for observations ≥ 3 days and observations ≥ 7 days. Results studies show that the RPR diagnostic test at observation ≥ 7 days is more sensitive and specific than at observation ≥ 3 days. This study shows that both observations ≥ 3 days and observations ≥ 7 days show similarity, where the RPR value is much higher in cases of mortality than in cases of alive.

Table 2. RPR diagnostic test observation ≥ 3 days and observation ≥ 7 days.

Variable	Death	Alive	Total	p-value
Observation ≥ 3 days				
RPR > 0,056	12 (66,7 %)	12 (36,4 %)	24 (47,1 %)	0.037
RPR < 0,056	6 (33,3%)	21 (63,6 %)	27 (52,9%)	
Sensitivity 66.7 %, specificity, 63.6 %, NR (+) 50%, NR (-) 77.7 %, RR 2.25				
Observation ≥ 7 days				
RPR > 0,072	16 (88,9%)	4 (12,1 %)	20 (39,2 %)	0.000
RPR < 0,072	2 (11.1 %)	29 (87,9%)	31 (60,8 %)	
Sensitivity 88.9 %, specificity, 87.9 %, NR (+) 80%, NR (-) 93.54 %, RR 12.5				

Several previous studies have shown that hematological parameters such as RDW, platelets, and RPR ratio have a correlation with the incidence of inflammation and oxidative stress at certain threshold values. One study concluded that RPR is an independent biomarker of poor prognosis in septic patients with a cut-off point of 0.134. Another study on burn patients showed that the RPR cut-off point ≥ 0.0726 was a predictor of mortality. Other studies found that the RPR cut-off point value ≥ 0.0713 was a predictor for mortality in patients with major burns. Meanwhile, in another study, the RPR cut-off point ≥ 0.108 was a predictor of mortality in cases of burns, with a sensitivity of 58.9% and a sensitivity of 82.7%.[13-21]

5. Conclusion

RPR value ≥ 7 days has prognostic value with better sensitivity and specificity in predicting mortality in burn patients.

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