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Original Article

Predictive value of red cell distrubition width and C reactive protein/albumin ratio in determining severe acute pancreatitis

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Abstract

Aim: To determine the relationship of red cell distribution width (RDW) and C-reactive protein (CRP)/albumin ratio with Ranson criteria, 2012 revised Atlanta Scoring and Balthazar Scoring in patients with acute pancreatitis (AP), which are used in daily practice to estimate the AP severity.

Material and Methods: RDW was documented from the complete blood count at the time of patient admission to the hospital. On the second day of hospitalization, the CRP/albumin ratio was calculated as the ratio of absolute CRP to albumin. The relationship between the patients' RDW levels and CRP/albumin ratio, with the length of hospital stay, and Ranson, Revised Atlanta criteria and Balthazar scores were investigated.

Results: In a total of 152 patients with a mean age of 51.58 ± 15.58 years (range: 19-76) were included in the study. Among participants 82 (53.9%) were female and 70 (46.1%) were male. Among study participants, according to Ranson criteria, 117 were having mild and 35 were having severe AP; regarding Atlanta classification, 116 were having mild and 36 were having severe AP and according to the Baltahazar classification 122 were having mild-moderate and 30 were having severe AP. The mean hospitalization period was 7.14 ±4.17 days (range: 2-27 days). RDW and CRP/albumin ratio are compared between mild-moderate and severe AP groups defined with Ranson, Atlanta and Baltahazar classifications. There was not any significant difference between groups regarding RDW values; however, CRP/albumin ratio was significantly different between groups defined with all three classifications (p: 0.001). There was not any correlation between RDW and any of the scores or hospitalization period; however, CRP/albumin ratio showed significant moderate correlation with all of the scores and hospitalization period.

Conclusion: We suggest that, CRP/albumin ratio is a good prognostic marker in predicting severe AP; however RDW values did not have any predictive value regarding the severity of AP.

Keywords: Acute; CRP/albumin; pancreatitis; RDW; severe

INTRODUCTION

Acute pancreatitis (AP) is an inflammatory disease of the pancreas gland that may cause local and systemic complications. Since the disease may cause severe organ damage and may have some fetal complications, assessment of disease severity is essential to determine therapeutic strategies (1). Although most of the AP cases are mild or moderate, severe AP develops in about 10-20% of patients and results in an intense inflammatory response that may cause severe local and systemic complications (2). Several scoring systems have been developed to predict the severity of AP. However, most of these scoring systems are contain many parameters and not easy to perform in daily practice. Inexpensive, easily available and cost-effective markers that can be used in patient admission and follow-up are warranted in AP (3).

The red blood cell distribution width (RDW) is a parameter evaluating the variability in the size of erythrocytes. It is a part of the complete blood count which is easily available in all over the world. Recently, RDW has been associated with many inflammatory conditions. In current literature, although there are some previous studies about the role of RDW in diagnosis and follow-up of patients with AP, the association of this parameter with other commonly used severity criteria is still not clear (4-6).

C-reactive protein (CRP) is a positive acute phase reactant

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synthesized by the liver against interleukin (IL) 1 and IL 6 and increases in inflammatory and infectious conditions within hours (7). CRP is one of the most useful biochemical markers used to determine the severity and complications of AP. On the other hand, albumin is a negative acute phase reactant also synthesized by the liver. CRP/albumin ratio is known to correlate with the severity of inflammation and mortality in inflammatory conditions (8, 9).

In this study, we aimed to determine the relationship of RDW and CRP/albumin ratio with Ranson criteria, 2012 revised Atlanta Scoring and Balthazar Scoring in AP patients, which are used in daily practice to estimate the AP severity.

MATERIAL and METHODS

Patients who were admitted to the emergency department of Okmeydanı Training and Research Hospital between January 2017 and April 2019 and diagnosed with acute pancreatitis by clinical, laboratory and imaging methods were included in the study. Comprehensive demographic, radiographic and laboratory data for all patients were collected retrospectively from hospital records. For the diagnosis of AP, the criteria for having at least two of the following three findings in one patient were sought;

1. Severe and sudden onset abdominal pain spreading to the back suggesting AP,

2. Serum amylase and lipase levels higher than 3 times normal,

3. Imaging findings (including abdominal ultrasound, computerized tomography) suggesting AP (10).

Patients diagnosed with AP regarding these criteria were included in the study. Patients with known chronic pancreatitis and pancreatic malignant disease, heart failure, peripheral vascular disease, hematologic disorder, acute or chronic inflammatory diseases, cancer and chronic liver disease, and patients under the 18 years of age were excluded.

Ranson criteria (11), 2012 revised Atlanta criteria (12) and the computerized tomography severity index (CTSI) were used to determine the severity of the disease. According to the Ranson criteria, patients with the score of 0-3 were accepted as mild AP and with the score between 4 and 11 were accepted as severe AP. Patients were divided into three groups according to the 2012 revised Atlanta classification as mild, moderate and severe pancreatitis. In the scales defined by Balthazar et al, the CTSI was based on the degree of necrosis, the presence of inflammation and fluid collections and the severity of pancreatitis was categorized as mild (0-3 points), moderate (4-6 points) or severe (7-10points) (13). Since the main purpose of this study was to differentiate severe AP from mild disease, mild and moderate AP patients were grouped into a single group and the findings were compared with severe AP patients.

RDW was documented from the complete blood count at the time of patient admission to the hospital. CRP and albumin values were recorded from patient files. On the second day of hospitalization, the CRP/albumin ratio was calculated as the ratio of absolute CRP to albumin. The relationship between the patients' RDW levels and CRP/albumin ratio, with the length of hospital stay, and Ranson, Revised Atlanta criteria and Balthazar scores were investigated.

The study was carried out in accordance with the Declaration of Helsinki and the study was approved by the Local Ethics Research Committee of Okmeydanı Education and Research Hospital.

Statistical Analyses

Statistical analyses were performed using SPSS version 21.0 software package (SPSS Inc, Chicago IL, United States). The distribution of data was analyzed with Kolmogorov-Simirnov test. Continuous variables with normal and non-normal distribution were presented as mean ± SD and median with range, respectively. Categorical data are reported as number (frequency). Student's t-test and Mann Whitney U test were performed to compare the data. Pearson and Spearman Correlation analyses were performed for normally and non-normally distributing data, respectively. ROC curves were constructed to evaluate the prognostic value of CRP/albumin ratio in predicting severe AP. A p-value < 0.05 was considered statistically significant.

RESULTS

In a total of 152 patients with a mean age of 51.58 ± 15.58 years (range: 19-76) were included in the study. Among participants 82 (53.9%) were female and 70 (46.1%) were male. The laboratory data obtained from the patients at admission are summarized in Table 1. In 75 (49.3%) of the patients the etiology of the AP was biliary while in remaining 77 (50.7%) patients, the etiology was non-biliary.

The mean albumin level on 2nd day of hospitalization was 3.91 ± 0.58 and the median CRP and CRP/albumin ratio were 60 mg/L (range: 10-468) and 16 (2 -145.3), respectively.

Among study participants, according to Ranson criteria, 117 were having mild and 35 were having severe AP; regarding Atlanta classification, 116 were having mild and 36 were having severe AP and according to the Baltahazar classification 122 were having mild-moderate and 30 were having severe AP. The mean hospitalization period was 7.14 ±4.17 days (range: 2-27 days).

RDW and CRP/albumin ratio are compared between mild-moderate and severe AP groups defined with Ranson, Atlanta and Baltahazar classifications (Table 2). There was not any significant difference between groups regarding RDW values; however, CRP/albumin ratio was significantly different between groups defined with all three classifications.

Table 1. Laboratory data of study participants at admission

	Mean ± Standard deviation	Range
Glucose (mg/dL)	138.62 ±58.45	52.00-356.00
White blood cell count (10^3/µL)	12.01 ±4.74	4.00-34.00
Hemoglobin (g/dL)	13.21 ±2.21	6.20-19.00
Platelet count (10^9/l)	254.38 ±77.73	117.00-560.00
RDW (fL)	13.19 ±1.75	9.40-18.80
ALT (IU/l)	117.61 ±157.89	10.00-987.00
AST (IU/l)	128.33 ±208.79	10.00-1629.00
GGT (IU/l)	214.62 ±292.35	9.00- 1741.00
Creatinine (mg/dL)	0.98 ± 0.28	0.41-3.00
LDH (IU/l)	308.75 ±205.49	112.00-1343.00
Amylase (IU/l)	1237.13 ±972.23	304.00-4917.00
Lipase (IU/l)	1376.38 ±1385.23	327.00-10013.00

RDW: red cell distribution width; ALT: alanine aminotransferase; AST: aspartate aminotransferase; GGT: Gamma glutamyl transferase; LDH: Lactate dehydrogenase

Table 2. Comparison of RDW and CRP/albumin ratio

	RDW (mean ±SD)	CRP/albumin (mean rank)
Ranson criteria		
Mild-Moderate (n:117)	13.14 ± 1.75	67.29
Severe (n:35)	13.36 ± 1.78	108.47
p	0.56	0.001
Atlanta classification		
Mild-Moderate (n:116)	13.17 ±1.77	67.29
Severe (n:36)	13.07 ±2.22	108.47
p	0.19	0.001
Baltahazar classification		
Mild-Moderate (n:122)	13.17 ±1.77	58.21
Severe (n:30)	13.07 ± 2.22	93.67
p	0.20	0.001

Correlation of RDW and CRP/albumin ratio with Ranson, Atlanta and Baltahazar scores and hospitalization period are summarized in Table 3. There was not any correlation between RDW and any of the scores or hospitalization period; however, CRP/albumin ratio showed significant moderate correlation with all of the scores and hospitalization period.

Table 3. Correlation of RDW and CRP/albumin ratio with Ranson, Atlanta and Baltahazar scores and hospitalization period

	Ranson criteria		Atlanta classification		Baltahazar classification		Hospitalization period	
	r	p	r	p	r	p	r	p
RDW	0.051	0.533	0.094	0.176	0.018	0.840	0.112	0.171
CRP /albumin ratio	**0.391**	**0.001**	**0.468**	**0.001**	**0.323**	**0.001**	**0.160**	**0.041**

ROC curves are drawn for CRP/albumin ratio in defining severe AP determined with Ranson, Atlanta and Baltahazar scores. Areas under the curve are summarized in Table 4 for all criteria. ROC curves are shown in Figures 1, 2 and 3.

Table 4. Area under the curve determined with ROC curve analysis drawn for CRP/albumin ratio in defining severe AP determined with Ranson, Atlanta and Baltahazar scores

	Area under the curve	95% Confidence Interval
Ranson criteria	0.771	0.682 - 0.860
Atlanta classification	0.821	0.741 - 0.901
Baltahazar classification	0.786	0.667 - 0.905

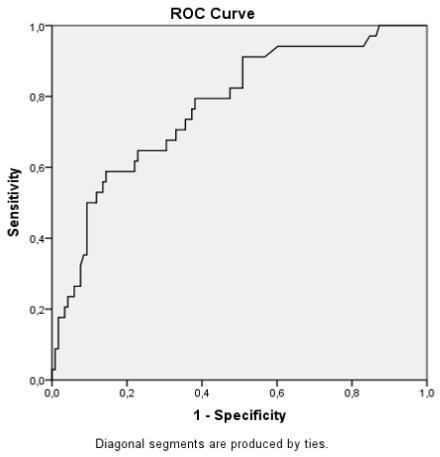

Figure 1. ROC curve drawn for CRP/albumin ratio in defining severe AP determined with Ranson criteria

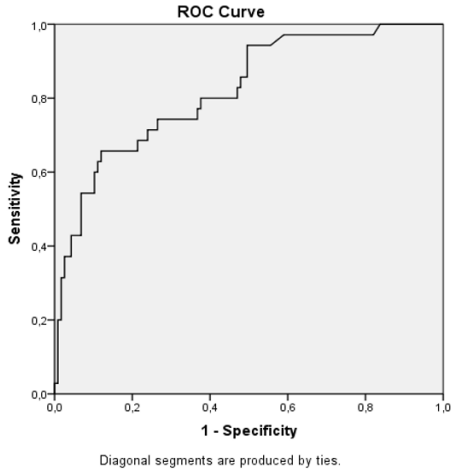

Figure 2. ROC curve drawn for CRP/albumin ratio in defining severe AP determined with Atlanta classification

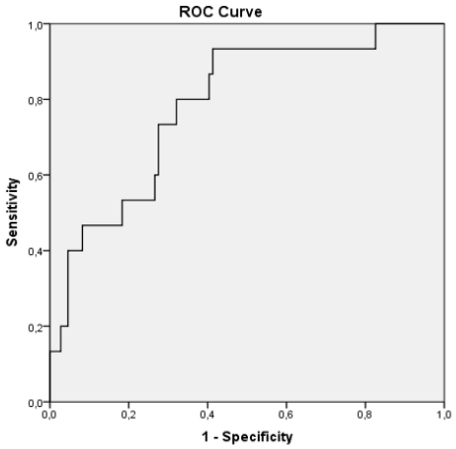

Figure 3. ROC curve drawn for CRP/albumin ratio in defining severe AP determined with Baltahazar classification

Cut-off values for CRP/albumin ratio in defining severe AP determined with Ranson, Atlanta and Baltahazar scores are summarized in Table 5. Regarding these data, CRP/albumin ratio determined on the 2nd day of hospitalization for AP, has good sensitivity and specificity at the value of 20.11 for defining severe AP determined according to Ranson criteria, at the value of 22.06 for defining severe AP determined according to Atlanta classification and at the value of 37.30 for defining severe AP determined according to Baltahazar classification.

Table 5. Cut-off values for CRP/albumin ratio in defining severe AP determined with Ranson, Atlanta and Baltahazar scores

Parameter	Sensitivity	Specificity
For Ranson criteria		
17.01	0.794	0.619
20.11	0.706	0.644
21.47	0.676	0.696
For Atlanta classification		
17.01	0.800	0.800
22.06	0.743	0.735
26.29	0.714	0.771
For Baltahazar classification		
20.65	0.86	0.60
27.50	0.80	0.68
37.30	0.73	0.73

DISCUSSION

In this study we analyzed the role of RDW and CRP/albumin ratio in estimating the severity of AP and we determined that; RDW values were not significantly different between mild-moderate and severe AP groups defined with Ranson, Atlanta or Baltahazar classifications. Moreover, RDW did not show any correlation with any of these criteria or hospitalization period in AP patients. On the other hand, CRP/albumin ratio was significantly different between mild-moderate and severe AP groups defined with all these three classifications. CRP/albumin ratio showed significant moderate correlation with all of the scores and hospitalization period in AP patients.

The role of RDW in diagnosis and management of AP has been studied in recent literature. Yao et al reported a significant association between RDW and mortality of patients with AP (14). In a recent meta-analysis Ganji et al (3) reported that RDW was an inexpensive marker with a moderate prognostic value to predict mortality in AP patients. Yalcin et al (15) reported that RDW at admission could be used to differentiate acute interstitial edematous pancreatitis or acute necrotizing pancreatitis and to determine the prognosis of acute pancreatitis in their study on 180 patients. RDW was also reported to be important in identification of patients at increased risk of severe acute pancreatitis on presentation (16). Kilic et al (17) reported high sensitivity and specificity values obtained from ROC curve for initial RDW and Ranson score in predicting severe AP. However, there was not any correlation between RDW and 0-hour Ranson score determined in that study. Zhou et al (18) reported that RDW was a reliable indicator for prediction of severe AP and defining 28-day mortality in their retrospective study on 406 patients. In a retrospective cohort study on 42 patients with severe AP, Zhang et al reported that RDW is a good prognostic marker in predicting the mortality of patients with severe AP (19). In contrary with these data, we did not determine any significant difference regarding the RDW values in patients with mild-moderate or severe AP defined with Ranson, Atlanta or Balthazar classifications.

We reported a significant difference in CRP/albumin ratio between mild-moderate and severe AP groups defined with other classifications. Moreover, CRP/albumin ratio showed significant moderate correlation with Ranson, Atlanta and Baltahazar scores and hospitalization period in AP patients. Similar with our results, Yilmaz et al reported that in a total of 264 patients diagnosed with AP, RDW value was not significantly different between mild, moderate or severe AP groups; while CRP/albumin values were significantly higher in the severe pancreatitis group compared with other groups (20). Kaplan et al (21) reported that CRP/albumin ratio was a significant marker in predicting mortality. Although the data regarding the CRP/albumin ratio in AP is limited, there are some studies regarding the CRP or albumin values in AP. C-reactive protein on 2nd day after disease onset is still considered to be one of the most commonly used biomarkers to predict the severity in AP (22). Li et al (23) reported that both CRP and RDW were independently associated with mortality in AP. Yarkac et al (24) reported a significant correlation between CRP values at admission and Ranson criteria. We analyzed the CRP/albumin ratio on 48th hour of admission and determined a significant correlation with other scoring and classification systems. Moreover CRP/albumin ratio was also significantly correlated with the hospitalization period of patients with AP. As clearly known, CRP is an acute phase reactant and albumin is a negative acute phase reactant and CRP/albumin ratio may be superior to CRP levels alone in defining the degree of inflammatory process in AP. Further prospective studies are warranted comparing the CRP alone and CRP/albumin ratio in predicting the outcomes of AP.

There are some limitations of this study that should be mentioned. First is the retrospective design and low number of patients included in this study. Secondly, we did not study on the long-term outcomes, complications, or mortality in AP patients.

CONCLUSION

In conclusion, in this study we determined that CRP/albumin ratio was significantly different between mild-moderate and severe AP groups defined with Ranson, Atlanta or Baltahazar classifications; and showed significant moderate correlation with all of these scores and hospitalization period in AP patients. However, RDW values were not significantly different between mild-moderate and severe AP groups and did not show any correlation with any of these criteria or hospitalization period in AP patients. We suggest that, CRP/albumin ratio is a good prognostic marker in predicting severe AP; however RDW values did not have any predictive value regarding the severity of AP.

Competing interests: The authors declare that they have no competing interest.

Financial Disclosure: There are no financial supports.

Ethical approval: The study was carried out in accordance with the Declaration of Helsinki and the study was approved bythe Local Ethics Research Committee of Okmeydani Education and Research Hospital.

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