Evaluation of Red Cell Distribution Width and Its Ratio to Total Serum Calcium as Predictors of Severity in Acute Pancreatitis

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Abstract:

Background: Acute pancreatitis (AP) is a serious medical condition that can pose significant risks to life, presenting with a range of severity levels.

Aims: To evaluate Red Cell Distribution Width and its ratio to total serum calcium as predictive markers for the severity of AP.

Material & Methods: The study recruited 70 patients more than >18 years who were admitted to the surgery department in our hospital. A total of 33 MAP patients and 37 MSAP/SAP patients were enrolled in the study. RDW was measured at baseline and 24 hr. The mean RDW at 0 hours for predicting AP was 0.685, exhibiting a sensitivity of 82.6% and a specificity of 74.8%. The ROC curve of RDW (%) at 24 hrs was determined to be 0.885. Serum calcium levels in MAP were significantly higher compared to those in the MSAP group ($p < 0.05$). RDW had a significant association with severity ($p < 0.05$).

Conclusion: RDW has been identified as an independent risk factor in predicting mortality in patients with acute pancreatitis. It is crucial to quickly recognize patients who are at a higher risk for severe outcomes in order to improve their prognosis through timely medical management.

Keywords: Acute Pancreatitis, Red Cell Distribution Width, Total Serum Calcium.

Introduction

Acute pancreatitis (AP) is a potentially life-threatening condition characterized by inflammation of the pancreas, with varying degrees of severity. The severity of AP can range from mild, self-limiting cases to severe, complicated forms that may lead to multi-organ failure and even death. Accurate prediction of disease severity is crucial for early intervention and management, as it guides therapeutic decisions, including intensive care unit (ICU) admission and monitoring.[1] Several biomarkers have been investigated for their prognostic value in predicting the severity of AP, and among them, Red Cell Distribution Width (RDW) and total serum calcium (Ca) have garnered attention.[2]

Red Cell Distribution Width (RDW) is a parameter routinely measured in complete blood counts that reflects the variation in the size of red blood cells. Elevated RDW has been associated with inflammation, oxidative stress, and poor clinical outcomes in a range of diseases, including cardiovascular conditions and various inflammatory disorders. Recent studies have suggested that RDW may also serve as a prognostic marker in AP, where increased RDW could correlate with greater severity of the disease.[3]

Total serum calcium(TSC) is another widely measured biomarker that plays a crucial role in numerous physiological processes, including cellular signalling and enzyme activity. Hypocalcemia, or low serum calcium levels, is a common finding in AP and has been linked to more severe disease manifestations, including pancreatic necrosis and multi-organ dysfunction.[4]

This article aims to evaluate the potential of RDW and its ratio to total serum calcium as predictive markers for the severity of acute pancreatitis. By examining their relationship with clinical outcomes, the study explores whether these easily accessible biomarkers can aid in early risk stratification, thus enabling clinicians to better assess the prognosis and guide treatment decisions. Understanding these biomarkers' predictive value could improve the management of AP and reduce associated morbidity and mortality.

Material & Methods

The present observational cross sectional study was conducted from March 2024 to November 2024 in our hospital. The study recruited 70 patients more than >18 years who were admitted to the surgery department. Each patient underwent comprehensive

history-taking, clinical examination, and relevant diagnostic tests. Acute pancreatitis was defined by the revised Atlanta criteria.

Patients with the chief compliant of acute onset, persistent, severe, epigastric pain often radiating to back abdominal pain. Serum lipase or amylase activity at least more than three times the upper limit of normal. Imaging showing characteristic findings of AP. Patients on immunosuppressive therapy, infectious condition, malignancy, chronic use of erythropoietin, recent transfusion history and pregnancy were excluded.

Statistical Analysis

Data was collected and compiled using Microsoft Excel and analyzed using SPSS version 23. 0. The continuous data were summarized as mean ± standard deviation. Frequency, percentage, means, and standard deviations (SD) were calculated for continuous variables, while ratios and proportions were determined for categorical variables. A p-value of less than 0. 05 was deemed statistically significant. To assess the significance of two means, the Student's t-test was employed.

Results

A total of 70 patients suffering from acute pancreatitis were recruited in the study. Out of which 33 were MAP patients & 37 were MSAP/SAP patients. All patients above 70 years had MSAP/SAP. No significant difference was observed between the two groups with regards to age. No gender differentiation was observed between cases of MAP, MSAP, and SAP. The mean urea, mean creatinine in patients with MSAP was statistically significantly higher than MAP group(p<0.05). In the present study, mean bilirubin (mg/dL) was not statistically significant in both the groups. Also mean SGOT & SGPT levels were comparable & no significant change observed between the two groups. ROC curve of RDW at 0 hour for predicting SAP was 0.685 with a sensitivity of 82.6% and specificity of 74.8%. ROC curve of RDW at 24 hr had a sensitivity of 85.5% & specificity of 78.5%. Serum calcium (mg/dL) in MAP were significantly higher compared to MSAP/SAP($p < 0.05$). RDW/TSC was 1.5 in MAP patients & 1.9 in MSAP/SAP patients.(Table 1)

Table 1

Parameters	MAP	MSAP/SAP	P value
Age	51.24±9.56	54.51±20.24	>0.05
Males	60.12%	68.32	>0.05
Hb	12.48%	13.24	>0.05
Blood urea	30.24 ±11.29	98.21±38.72	<0.05
Serum creatinine	0.71±0.24	2.19±0.82	<0.05
Serum bilirubin	1.69±1.24	2.41±1.83	>0.05
SGOT	98.73±67.01	88.4±62.43	>0.05
SGPT	210.19±89.46	172.41±120.2	>0.05
ALP	209.12±205.22	384.12±241.13	<0.05
RDW (%) AT 0 Hr	12.92±1.29	16.1±1.56	<0.05
RDW (%) AT 24 Hr	12.51±1.42	14.64±2.02	<0.05
Serum calcium	9.06±0.52	8.01±0.48	<0.05
RDW/TSC ratio	1.24±0.19	1.81±0.22	<0.05

Discussion

In the present study, a total of 70 patients diagnosed with acute pancreatitis were enrolled. All patients aged over 70 years were classified as having mild to severe acute pancreatitis (MSAP/SAP). There was no significant age-related difference noted between the two groups. Additionally, no gender disparities were found among the cases of MAP, MSAP, and SAP. This aligns with the findings of Zhang et al.[5], Gravito-Soares et al.[6], and Peng et al[7]. Age plays a crucial role in acute pancreatitis, as older individuals tend to experience more severe manifestations of the disease and a poorer prognosis.

In the present study, gallstones emerged as the predominant cause of acute pancreatitis. This finding aligns with the research conducted by Ye et al.[10] and Gülen et al.[11] Gallstones, including microlithiasis, account for 40 to 70 percent of acute pancreatitis cases.[12]Two potential mechanisms have been proposed as triggers for gallstone-related pancreatitis: the reflux of bile into the pancreatic duct caused by a temporary blockage of the ampulla during the movement of gallstones, or obstruction at the ampulla due to the presence of stones or edema resulting from the passage of a stone.[13]

In the present study, the average levels of urea and creatinine in patients diagnosed with MSAP were found to be significantly higher than those in the MAP group. This finding aligns with the research

conducted by Zhang et al., which indicated a positive correlation between RDW values and blood urea nitrogen (BUN) levels ($p < 0.05$).[5]

Conversely, the mean bilirubin levels (mg/dL) did not show any statistically significant differences between the two groups. Additionally, the mean levels of SGOT and SGPT were comparable, with no notable changes observed between the groups. In agreement with these findings, the study by Shivakumar C and Kampani G in 2024[13], as well as Zhang et al.[5], reported no significant correlation between RDW and the levels of SGOT and SGPT.

Furthermore, a significant association was identified between RDW (%) at baseline and severity ($p < 0.05$). Comparable results were reported in studies by Gravito-Soares et al.[6], Han et al.[14], and Yao and Lv,[15] which demonstrated that RDW was significantly elevated in patients with MSAP/SAP compared to those with MAP. These studies also noted an inverse correlation of RDW with calcium, serum albumin, RBC count, and hemoglobin, while a direct correlation was observed with age and LDH levels.

In the present study, the ROC curve for RDW at 0 hours in predicting SAP was determined to be 0.685, exhibiting a sensitivity of 82.6% and a specificity of 74.8%. Likewise, the research conducted by Gravito-Soares et al.[6] indicated that RDW at 0 hours served as a significant predictor of SAP, with a cutoff value established at 13.0. Additionally, a study by Yao and Lv demonstrated that RDW displayed a sensitivity of 75% and a specificity of 89.8% in forecasting mortality, highlighting that RDW levels were significantly higher in nonsurvivors of acute pancreatitis (AP) when compared to both healthy individuals and survivors of AP.

In this study, the ROC curve for RDW at 24 hours revealed a sensitivity of 85.5% and a specificity of 78.5%. Correspondingly, the findings of Gravito-Soares et al.[6] indicated that RDW at 24 hours was recorded at 14.3 ± 1.9 in patients with mild acute pancreatitis (MAP) and 12.8 ± 0.5 in those with moderate/severe acute pancreatitis (MSAP/SAP), with a statistically significant difference ($p < 0.001$). This suggests that both RDW at 0 hours and RDW at 24 hours are excellent indicators of mortality in acute pancreatitis.

Furthermore, our study found that serum calcium levels (mg/dL) in patients with MAP were significantly elevated compared to those with MSAP/SAP ($p < 0.05$). Similar findings were reported by Yao and Lv, who noted serum calcium levels (mmol/L) of 2.11 ± 0.24 in MAP patients and 2.03 ± 0.19 in MSAP/SAP patients, with a significant difference ($p < 0.001$). Multifactorial

logistic regression analysis conducted by Ye et al. identified serum calcium as an independent predictor of the severity of acute pancreatitis.

In our analysis, the RDW/TSC ratio was found to be 1.5 in MAP patients and 1.9 in those with MSAP/SAP. These results align with those of Gravito-Soares et al., who reported RDW/TSC values of 1.8 ± 0.4 and 1.3 ± 0.1 for MAP and MSAP/SAP patients, respectively ($p < 0.001$).

Thus, RDW has been identified as an independent risk factor for predicting mortality in patients with SAP, as demonstrated by both multivariate logistic regression analysis and univariate analysis, similar to the Acute Physiology and Chronic Health Evaluation II (APACHE II) score and the Sequential Organ Failure Assessment (SOFA) score.

Conclusion

Acute pancreatitis is a serious medical condition that can pose significant risks to life, presenting with a range of severity levels. It is crucial to quickly recognize patients who are at a higher risk for severe or fatal outcomes in order to improve their prognosis through timely medical or endoscopic treatment and transfer to a specialized intensive care unit (ICU). Red cell distribution width and the RDW/TSC ratio are indicators of severity in acute pancreatitis. These measures provide a cost-effective and easily obtainable method for assessing disease severity upon admission, thereby enabling prompt intervention from the beginning.

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