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Red cell distribution width as a predictor of outcome in acute pancreatitis in Children

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Abstract

Background: Acute pancreatitis is a commonly encountered emergency in children but it has always been tough to predict accurately which subset of patients will become systemically unwell. Simple prognostic markers, such as red cell distribution width (RDW). This study was done to assess the usefulness of this marker. **Methods:** This observational study was conducted from July 2018 to June 2020 at the Department of Pediatric Gastroenterology and Nutrition, BSMMU, Dhaka. Thirty-one children with abdominal pain diagnosed with acute pancreatitis were included in the study. **Results:** The mean age of the pediatric patients was 11.19 (±3.45) years. The mean red cell distribution width was 14.99 (±2.96). RDW<14 was found in 15 cases (48.38%) and RDW ≥14 was found in 16 cases (51.62% Six patients (46.2%) with RDW<14 had complications while seven patients (53.8%) with RDW ≥14 had complications.). The mean Length of hospital stay (LOS) for RDW ≤14 group was 9.8 days while that of the RDW >14 group was 9.13 days. **Conclusion:** It was found that elevated RDW on admission had unfavorable clinical outcomes for pediatric patients with acute pancreatitis although statistical significance could not be established. Further multicenter studies with larger sample sizes are required to make some clinically applicable inferences.

Keywords: Red cell distribution width, Acute pancreatitis

Introduction

Acute pancreatitis (AP) is a commonly encountered emergency in children and the incidence has increased in the last two decades[1], ranging from 3.6 to 13.2 cases per 100,000 children[2,3] with a mortality rate between 4% and 10%.[4,5] Acute pancreatitis in children is diagnosed in the presence of at least two of the following criteria: sudden onset of abdominal pain compatible with acute pancreatitis, elevation of serum amylase and/or lipase more than three times of the upper limits of normal and characteristic imaging findings compatible of acute pancreatitis.[6] Characteristic findings include pancreatic edema, fat stranding, and peripancreatic fluid collections on abdominal imaging.[7] In infants and toddlers, symptoms may be subtle, vomiting, irritability and abdominal distension may suggest AP.[8]

The serum amylase has been the universal laboratory test used to establish the diagnosis of acute pancreatitis.[9] The specificity for a serum amylase in determining acute pancreatitis can be increased by using a cutoff of more than 2 to 3 times the upper limit of normal.[10] Also in AP, serum lipase is usually increased within 6 hours of symptoms; serum levels peak at 24 to 30 hours and can remain elevated for more than 1 week. Some advocate that serum lipase without serum amylase is sufficient to diagnose AP, as lipase is a more sensitive and specific marker of AP (87%–100% and 95%–100%, respectively).[6]

Up to 25% of AP cases in children have complications. Several clinical scoring systems for predicting severity, e.g., Ranson and Glasgow modified scores, have been adopted based on studies in adult populations; consequently, their validity in pediatric patients is limited. The Pediatric Acute Pancreatitis Severity Score (PAPS) was the first severity prediction score designed with data obtained from children, with a sensitivity of 70%.[11] Later, developed a scale for the Japanese

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pediatric population (JPN), obtaining a sensitivity of 80%.[12]

Red cell distribution width (RDW) is a laboratory parameter routinely reported in our institution as part of the full blood count, which is a measure of erythrocyte anisocytosis – the variation in the size of circulating red blood cells. A higher RDW implies a greater degree of anisocytosis. Elevated RDW has been shown to predict poor outcomes in septic shock, acute myocardial infarction and critically ill patients in general.[13] It has previously been identified as a potential biomarker for the prediction of morbidity and mortality in acute pancreatitis.[14,15] It has been suggested that RDW increases in severe acute pancreatitis because the systemic inflammatory response suppresses haematopoiesis & erythrocyte maturation, leading to increased levels of circulating immature reticulocytes, which are larger.[14]

So, this study aimed to assess the usefulness of elevated red cell distribution width (RDW) on admission as a predictor of severity and poorer clinical outcomes for patients with acute pancreatitis, especially in children.

Materials and methods

This cross-sectional descriptive study was carried out in the Department of Pediatric Gastroenterology and Nutrition, BSMMU, Dhaka, Bangladesh. From July 2018 to June 2020. Children with abdominal pain diagnosed as acute pancreatitis as per INSPPIRE criteria were included in this study.[6] Any other co-morbid condition except the consequences of acute pancreatitis, patient with chronic pancreatitis and patient with pain abdomen due to other causes were excluded. A total of 31 Cases were selected purposely from children presenting with abdominal pain diagnosed as pancreatitis admitted at the Department of Pediatric Gastroenterology and Nutrition, BSMMU. During recruitment, the objectives of the study were explained to the parents and written consent was obtained.

The detailed clinical history, physical examination findings and investigation reports were recorded in a predesigned standard data sheet. Blood samples were collected in the department of Pediatric Gastroenterology and Nutrition for laboratory workup. Complete blood count (CBC) report from each patient on admission was obtained to see the red cell distribution width (RDW) from the Department of Hematology of BSMMU. Outcomes of acute pancreatitis were observed in terms of cure, survival or mortality. The overall length of in-patient stay (LOS) was assessed as a secondary outcome. Data was analyzed by SPSS for Windows (using version 25.0).

All continuous variables were presented as mean. Statistical significance was determined by Chi-square (or Fisher's Exact test where applicable). For all statistical tests $p<0.05$ was considered as statistically significant.

Ethical issues

The study did not involve any social, psychological or legal risk to patients and their families and the study was approved by the Institutional Review Board (IRB), BSMMU.

Results

A total of 31 patients were included in this study. The mean age of the pediatric patients was 11.19±3.45 years. The mean red cell distribution width was 14.99±2.96. Total thirty patients (97%) recovered and one patient (3%) expired in hospital stay. (Table 01)

Table 01: Summary of Patients' characteristics

Characteristics	Frequency (percentage)
Total number of patients	31
Male	14 (45%)
Female	17 (55%)
Mean age	11.19±3.45 years
Minimum age	3.8 years
Mortality	1 (3%)

Thirteen patients (41.9%) developed complications among which ascites were most frequently found (12, 38.7%). Six patients (46.2%) with RDW<14 had complications while seven patients (53.8%) with RDW ≥14 had complications. Nine patients with RDW<14 did not have any complications while the equal number of patients with RDW ≥14 had no complications. The results were not statistically significant. (Table 02 & 03)

The mean length of hospital stays (LOS) for RDW ≤14 group was 9.8 days while that of the RDW >14 group was 9.13 days.

Table 02: Outcomes of the studied population (n=31)

Traits	Frequency	Percentage (%)
Recovery	30	97
Ascites	12	38.7
Pleural Effusion	7	22.6
Pancreatic necrosis	6	19.4
Pancreatic fluid collection	5	16
Hypocalcaemia	4	12.9
Shock	3	9.7
Pancreatic cyst/pseudocyst	2	6.5

Table 03: Correlation between complications and RDW (n=31)

Complications	RDW		Fisher's Exact Test	p-value
	≤ 14 (%)	>14 (%)		
Ascites	5 (33.5)	7 (43.8)	0.354*	0.716
Pleural effusion	4 (26.7)	3 (18.8)	0.278	0.685
Hypocalcaemia	2 (13.3)	2 (12.5)	0.005	1.00
Pancreatic necrosis	1 (6.7)	5 (31.3)	2.998	0.172
Shock	1 (6.7)	2 (12.5)	0.301	1.00
Pancreatic cyst	0 (0.0)	2 (12.5)	2.004	0.484

Table 04: Cross tabulation between RDW and complications (n=31) (Chi-square test)

RDW	Complications		χ^2	p-value
	Yes n (%)	No n (%)		
≤ 14	6 (46.2)	9 (50.0)		
>14	7 (53.8)	9 (50.0)		
			0.45	0.833
Total	13 (100.0)	18 (100.0)		

Discussion

In the present study, the mean age of the pediatric patients was 11.19±3.45 years. The minimum age of presentation was 3.8 years and 20 (64.51%) patients were aged > 10 years. Several studies have reported an increasing incidence of acute pancreatitis in all pediatric age groups over the past two decades.[16,17] In a study that included 55,012 children with acute pancreatitis, the disease was found to be more likely to occur in children older than 5 years old (median age, 17 years) and to occur slightly more frequently in girls than in boys.[17]

Pancreatitis causes substantial morbidity in the pediatric population. It is estimated that 2-13 new cases occur annually per 100,000 children.[18] Nearly one-quarter of children with acute pancreatitis develop severe complications, and the mortality rate is approximately 4-10% despite significant advances in the treatment of this disease.[17,19] According to a study, the median inpatient length of stay for children with pancreatitis in 2009 was 4 days.[17] In the current study the median inpatient length of stay was higher i.e. 9 days. Lack of skilled manpower, adequate beds and diagnostic facilities could be causes for such discrepancy.

Most of the patients (14, 45.2%) were suffering from colicky type of pain and six patients (19.4%) had diffuse type of pain. The epigastric region was the main location of pain for 21 patients (67.7%). Weizman and Durie (1988) reported abdominal pain is an important early symptom in children with AP.[20] Ziegler et al. (1988) also reported similar findings.[21] Musabbir et al. also found similar findings of the main location of pain in their study.[22]

Most (29, 93.5%) of the respondents were suffering from vomiting. Fever was present in 20 patients (64.5%). Eleven patients (35.5%) gave a history of fatty food intake and six patients (19.4%) gave a history of drug intake. Besides abdominal pain, Karami and Dabirian reported vomiting, abdominal discomfort, tachycardia, fever, hypotension, jaundice and back pain as other important sign symptoms of acute pancreatitis in paediatric patients.[23]

Out of 13 cases (41.9%) who developed complications, 12 patients (38.7%) developed ascites and 7 (22.8%) patients had pleural effusion. Three patients were presented with shock (9.7%). Among local pancreatic complications, pancreatic necrosis was found in 6 (19.4%) patients while pancreatic pseudocyst was found in only two patients (6.5%). A study with 50 pediatric patients with acute pancreatitis from BSMMU showed that 6% of patients had pancreatic pseudocyst and pancreatic necrosis was observed in 2% of cases.[22] They also found hypocalcemia in 38% of patients (22), but in this study four patients (12.9%) had hypocalcemia.

The mean red cell distribution width (RDW) was 14.99±2.96. Hassan et al. (2018) reported a mean RDW% of 15.03 for non-survivors and a mean RDW% of 12.5 for survivors ($p<0.05$).[24]

Early deaths (within the first week) due to severe AP are generally caused by massive inflammatory responses, which result in multiple organ failure, and late deaths (after 1-3 weeks) are caused by multiple organ dysfunction with infections and sepsis.[25,26] Recent studies found that RDW for predicting mortality was used in cardiovascular diseases, acute dyspnoea and pulmonary diseases.[27-29] In the current study patients were also categorized into two groups based on RDW%. Six patients (46.2%) with RDW<14 had complications while seven patients (53.8%) with RDW ≥14 had complications. Nine patients with RDW<14 did not have any complications while the equal number of patients with RDW ≥14 had no complications. However, these differences were not statistically significant. Wang et al. examined the RDW values in 120 AP patients and found that the mortality rate was

significantly higher in patients with RDW >13.4% than those with RDW <13.4%.[15]

Conclusion

Acute pancreatitis in children is an increasing health problem. The current study was done to assess the usefulness of red cell distribution width (RDW) as a predictor of the in-hospital outcomes in patients with acute pancreatitis in children. It was found that elevated RDW on admission had an unfavorable clinical outcome for patients with acute pancreatitis, although the statistical significance was not established.

Limitations of the study

The current study had the following limitations:

- Small sample size.
- Single center study.
- A cross-sectional design and single mortality limit the ability to assess the sensitivity and specificity of RDW in predicting mortality in patients.
- It focused on the predictive role of the marker on admission, so any potential predictive value of changes in the RDW over time was not assessed. These methods of risk prediction were not directly compared with established clinically used criteria, such as Glasgow-Imrie, Ranson, or APACHE II.

Recommendations

Based on the study findings the following recommendations are made:

- There is a role for using RDW on admission to predict severity and outcomes for patients with pediatric acute pancreatitis.
- Further multicenter well-designed, large sample-sized study should be done to establish the statistical significance.

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