

Original Article

Assessment of Severity of Acute Pancreatitis in Children: Systemic Inflammatory Response Syndrome (SIRS) Score

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Abstract

Acute pancreatitis (AP) is a prompt inflammatory process of the pancreas and it may be ranged from mild to severe pancreatitis with variable involvement of regional tissues and remote organ systems. Though there are many scoring systems for adults but scarce of scoring system for assessing the severity of acute pancreatitis among paediatric cases increase their suffering. Systemic Inflammatory Response Syndrome (SIRS) can be useful for assessing the severity of acute pancreatitis in children. It is reported that SIRS has good sensitivity, specificity, positive

predictive value and negative predictive value. The aim of this study was to assess the severity of acute pancreatitis in paediatric cases from the scores of SIRS. This cross-sectional study was conducted in the Department of Paediatric Gastroenterology and Nutrition, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh for a period of 1.5 years from May 2019 to October 2020. A total of 30 children with acute pancreatitis were selected purposively and SIRS was evaluated. The sensitivity, specificity, positive predictive value and negative predictive value of SIRS was calculated. Out of 30 acute pancreatitis children, 21 (mean age, 11.27±3.0 years) were diagnosed as mild AP and 9 (mean age, 10.53 ±5.0 years) as severe AP. Eighteen (60.0%) children were male and less than half 12 (40%) of children had pallor and most of them 24 (80%) had abdominal tenderness. There was no statistically significant difference between mild and severe AP in terms of serum lipase, amylase, BUN and CRP ($p > 0.05$). SIRS score was ≥ 2 in 9 (100%) severe AP patients and score was ≥ 2 in 7 (33.3%) mild AP patients and it was statistically significant ($p=0.001$). Sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of SIRS score in predicting severe acute pancreatitis was 100%, 77.8%, 63.6%, 100% and 84% respectively. This study finds that SIRS score can effectively assess the severity of acute pancreatitis in the paediatric age group. Systemic Inflammatory Response Syndrome (SIRS) score at admission can be used to assess the severity of acute pancreatitis.

Keywords: Acute pancreatitis, systemic inflammatory response syndrome, sensitivity, specificity, positive predictive value and negative predictive value.

INTRODUCTION

Pancreatitis is a disease in which pancreas becomes inflamed and presence of histological inflammation within the parenchyma of pancreas.¹ Digestive zymogens inside the acinar cells responsible for the condition. Acute pancreatitis (AP) is a sudden inflammation that lasts for a short time and range from mild discomfort to a severe and life-threatening illness.² Chronic pancreatitis is a long-lasting inflammation and happens after an episode of acute pancreatitis. Nearly a quarter of children with acute pancreatitis have severe

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clinical course and develops complications like organ dysfunction and local complications.

In the last two decades, the incidence of acute pancreatitis (AP) among the children has increased,³ varying from 3.6 to 13.2 cases per 100,000 children.⁴ Mortality rate is around 4 to 10% despite significant advances in the treatment of this disease.^{5,6} The extent of the inflammatory response of the pancreas determines the severity of AP that can lead to complications such as pancreatic necrosis, effusions, shock, leads rapidly to multiple organ failure and even death. In infants and toddlers, symptoms may be subtle, vomiting, irritability and abdominal distension may suggest AP.⁷ Initially, the duration of pain is quite variable, ranging from several hours to several days. As the disease progress, the attacks become more frequent and pain-free intervals shrink and vanish. Less common initial presentations include, sequel of exocrine or endocrine insufficiency: steatorrhea, weight loss and diabetes, biliary obstruction with recurrent episodes of mild jaundice, cholangitis, or vague attacks of indigestion.⁸

AP can be classified into mild, moderately severe, or severe and early identification of patients at higher risk of developing Severity of Acute Pancreatitis (SAP) may improve outcomes by providing more aggressive management.⁵ The available scoring systems do not perform well in children, even PAPS and JPN score that is for pediatric population. No single parameter has been developed which is suitable for the early prediction of acute inflammation and necrosis.⁹ The use of systemic inflammatory response syndrome (SIRS) as a simple screening tool at admission to identify children at risk for the development of Severity of Acute Pancreatitis. Systemic inflammatory response syndrome (SIRS) is an easy tool to identify children at risk for the development of severe acute pancreatitis. In patients with AP, the various inflammatory events cause intra-pancreatic injury and extra-pancreatic inflammation that has been termed the

systemic inflammatory response syndrome (SIRS).¹⁰ In adults, early ≥ 2 SIRS score, has been found to be associated with severe AP and persistent ≥ 2 SIRS score associate with multisystem organ failure and mortality. Criteria for SIRS in children include tachycardia (or bradycardia in infants <12months), tachypnea, elevated or suppressed body core temperatures, and leukocytosis or leukopenia. The presence of each of the 4 SIRS criteria can be easily assessed at the time of admission and as a “score” from 1 to 4 and represent an important means of identifying pediatric patients with AP at increased risk for severe disease.¹¹ In addition, SIRS can be calculated by very simple clinical and lab parameters. In absence of pediatric specific criteria for severe AP, SIRS score at admission may serve as an easy to calculate severity. The use of SIRS as a simple screening tool at admission to identify children at risk for the development of SAP. In this study, the aim was to determine the severity of acute pancreatitis by SIRS and utility of this in severity assessment of pediatric acute pancreatitis. The result of the study might be helpful for the physicians in early and meticulous diagnosis of severe acute pancreatitis who have more chance of development of complications.

MATERIALS AND METHODS

This was a cross-sectional study done from May 2019 to October 2020 in the Department of Pediatric Gastroenterology and Nutrition, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh. Children less than 18 years with abdominal pain admitted at the Department of Paediatric Gastroenterology and Nutrition, Bangabandhu Sheikh Mujib Medical University, diagnosed as acute pancreatitis according to INSPIRE (International Study Group of Pediatric Pancreatitis: In Search for a Cure) criteria considered as study population. Patient with acute recurrent pancreatitis, chronic pancreatitis, pain in the abdomen due to other causes were excluded from the study.

Systemic Inflammatory Response Syndrome (SIRS) scoring system:					
Pediatric SIRS Criteria: The presence of 2 or more of the following criteria defines SIRS. ^{12,13}					
Age Group	Heart rate beats/min		Respiratory rate breaths/min	Leukocyte Count Leukocytes 10 ³ /mm ³	Temp °C
	Tachy cardia	Brady cardia			
Newborn (0 d to 1 wk)	>180	<100	>50	>34	>38°C or <36°C
Neonate (>1 week to 1 mo)	>180	<100	>40	>19.5 or <5	>38°C or <36°C
Infant (>1 mo to 1 y)	>180	<90	>34	>17.5 or <5	>38.5°C or <36°C
Toddler and preschool (>1 to 5 y)	>140	NA	>22	>15.5 or <6	>38.5°C or <36°C
School age (>5 to 12 y)	>130	NA	>18	>13.5 or <4.5	>38.5°C or <36°C
Adolescent (>12 to <18 y)	>110	NA	>14	>11 or <4.5	>38.5°C or <36°C

NA= Not applicable.

Data collection:

After enrollment in the study at first history was obtained from the children/ parents/ caregivers and physical examination was done by researcher herself at the day of admission. History was taken in details and 5 ml venous blood was collected aseptically for laboratory investigation. Total count of WBC, S. creatinine, RBS, S. ALT and S. calcium were investigated and other laboratory investigations such as serum amylase, serum lipase, blood urea nitrogen, C-reactive protein were also assessed in Department of Biochemistry, BSMMU by autoanalyzer machine. After getting the reports of total count of WBC, patient's SIRS scoring was done and documented in questionnaire. A semi-structured questionnaire was used to collect data from the patients and recording the examination findings and investigation findings.

Statistical analysis:

Data were analyzed by SPSS software, version-25.0. Categorical variables were reported by frequency and percentage and compared by the Chi-square or Fisher exact test. All normally distributed continuous variables were presented by mean and standard deviation and compared by Independent sample t test. Continuous variables without normal distribution were reported by median and interquartile range and compared by Mann-Whitney test. Sensitivity, Specificity, positive predictive value, negative predictive value, diagnostic accuracy of SIRS was observed by comparing with NASPGHAN guideline definition of mild and severe AP. A *p*-value <0.05 was considered statistically significant for all tests.

Ethical consideration:

Institutional ethical committee approval was taken before commencement of the study. A consent form was constructed describing the title, objectives, procedure of the study, expected outcome, any potential risk to the subject etc. These statements were written in an easily understandable clear local language. Parents or caregiver decided themselves to be or not to be included in the study. This written informed consent was signed duly by the parents and principal investigator.

RESULTS

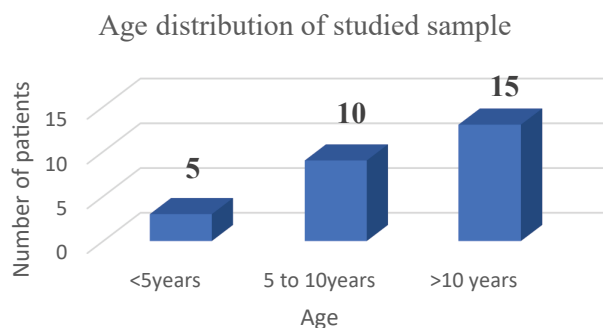


Figure- 1: Age distribution of studied samples (n=30)

Figure 1 states that among the studied sample, highest frequency of cases was seen in >10-year age group (15), followed by 5-10 year (10) age group and < 5 year (5) age group (Figure 1).

Gender distribution of studied sample

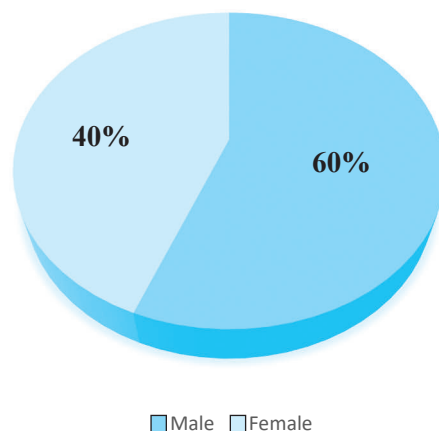


Figure- 2: Gender distribution of studied sample (n=30)

Figure 2 shows that among the studied samples, 18 (60%) were male and 12 (40%) female (Figure 2).

Distribution of studied sample by severity

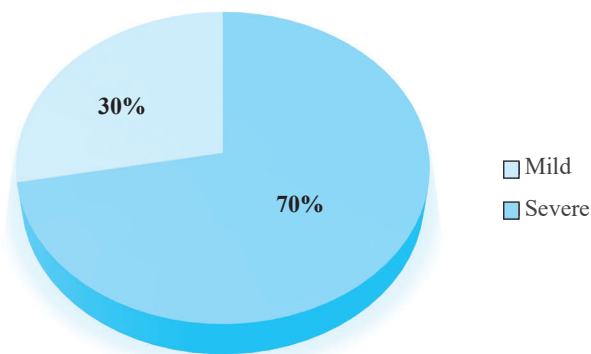


Figure- 3: Distribution of studied sample by severity (n=30)

Figure 3 shows that 21 (70%) cases were mild and 9 (30%) belongs to severe acute pancreatitis according to NASPGHAN classification (Figure 3).

Table I presents that out of 25 studied samples, 11 patients had pallor (44%) and shock was present in 4 (16%) of the patients. Most of patients had abdominal tenderness 23(92%), five (20%) patients had detectable ascites on clinical examination (Table I).

Table- I: Distribution of studied sample by physical findings (n=30)

	Findings	No	Percentage (%)
General findings	Pallor	12	40
	Jaundice	1	4
	Shock	6	20
	Dehydration	1	4
Abdominal findings	Abdominal tenderness	24	80
	Liver enlargement	4	16
	Ascites	6	20

Table II shows that there was no statistically significant difference of total count, S. creatinine, RBS and S. ALT between mild and severe AP ($p > 0.05$) but serum calcium level was significantly higher in mild AP than severe AP ($p = 0.001$).

Table- II: Comparison of haematological and biochemical parameters between mild AP and severe AP (n=30)

Variable	Total (n=30) Mean±SD	Mild AP (n=21) Mean±SD	Severe AP (n=9) Mean±SD	p value
Total count (K/mm ³)	11.61±3.63	12.77±2.47	16.14±7.99	0.86
S. Creatinine (mg/dL)	0.69±0.66	0.63±0.12	0.88±0.91	0.07
RBS (mmol/l)	7.25±1.26	6.26±1.12	6.10±1.32	0.99
S. ALT (IU/L)	28.26±4.31	25.0±11.03	30.71±12.1	0.28
S. Calcium	9.22±0.86	9.8±0.67	10.4±0.51	0.001s

Independent sample t test was used to analyze data. s= significant

Table III states there was no statistically significant difference between mild and severe AP in terms of serum lipase, amylase, BUN and CRP ($p > 0.05$).

Table- III: Comparison of biochemical markers between mild AP and severe AP (n=30)

Variable	Mild AP (n=21)	Severe AP (n=9)	p value
	25th -75th percentile	25th -75th percentile	
Lipase (U/L)	710.0 (308.75-2578.5)	888.0 (558.0-2690.0)	0.67
Amylase (U/L)	478.0 (270.25-1050.0)	1481.0 (120.0-2090.0)	0.57
BUN (mg/dL)	10.13 (8.39-17.00)	11.0 (6.90-13.0)	0.27
CRP (mg/L)	18.36 (5.13- 36.36)	42.520 (12.82-58.17)	0.22

Mann-Whitney U test

Table IV shows that there was no significant ($p=0.51$) difference noted in weight among mild AP group (35.38 ± 14.70 Kg) and severe AP (40.57 ± 22.83 Kg) group. And non-significant difference was noted in height and BMI for age with p value 0.48 and 0.99 respectively.

Table- IV: Comparison of weight, height and BMI for age between mild AP and severe AP group (n=30).

Variable	Total (n=30) Mean±SD	Mild AP (n=21) Mean±SD	Severe AP (n=9) Mean±SD	p value
Weight (Kg)	36.84±17.00	35.38±14.70	40.57±22.83	0.51
Height (cm)	136.86±20.37	135.03±19.08	141.57±24.35	0.48
BMI (kg/m ²) for age	18.53±5.43	18.54±5.08	18.51±6.71	0.99

Independent sample t test

Table V contains that there was no statistically significant difference of age and hospital stay between mild and severe AP ($p=0.86$ and $p=0.13$, respectively). But there was statistically significant difference in terms of duration of pain and NPO days between the two groups ($p=0.002$ and $p=0.02$, respectively).

Table- V: Comparison of age, hospital stay, pain duration and NPO days between mild and severe AP (n=30).

Variable	Total (n=30) Mean±SD	Mild AP (n=21) Mean±SD	Severe AP (n=9) Mean±SD	p value
Age (yrs)	10.35±3.28	10.27±4.0	10.54±4.0	0.86
Hospital stay (days)	9.36±3.38	8.72±3.48	11.00±2.65	0.13
Duration of pain (days)	7.64±4.97	5.83±3.58	12.28±5.25	0.002s
NPO (days)	2.00±1.41	1.61±1.2	3.00±1.53	0.02

Independent sample t test, s-significant

Table VI presents that there was statistically significant difference in terms of systolic BP, diastolic BP, pulse and respiratory rate between mild and severe AP group ($p=0.007$, $p=0.003$, $p=0.0001$ and $p=0.004$, respectively). But there was no statistically significant difference of mean temperature between the two groups ($p=0.13$) (Table VI).

Table- VI: Distribution of vital signs between mild AP and severe AP (n=30).

Variable	Total (n=30) Mean±SD	Mild AP (n=21) Mean±SD	Severe AP (n=9) Mean±SD	p value
Temperature (F)	98.58±1.48	98.3±0.83	99.31±2.44	0.13
Systolic BP (mmHg)	95.6±13.79	100.0±10.28	84.28±15.92	0.007 s
Diastolic BP (mmHg)	60.8±11.24	64.72±8.48	50.71±11.70	0.003 s
Pulse (bpm)	102.36±17.54	94.00±10.82	123.85±12.28	0.0001 s
Respiratory rate/min	22.48±3.38	21.33±2.37	25.42±3.95	0.004s

Independent sample t test, s- significant

Table VII comparing the severe and mild AP on the basis of SIRS score revealed, 9 (100%) patient of severe AP group (n=9) had SIRS score of ≥ 2 and 7 (33.3%) out of 21 patients in mild AP group had ≥ 2 score and it was statistically significant ($p=0.001$).

Table- VII: Comparison of SIRS score between mild AP and severe AP (n=30).

		Severity of acute pancreatitis based on NASPGHAN criteria			p-value
		Severe	Mild	Total	
Severity by	Severe (score ≥ 2)	9	7	16	0.001s
SIRS score	Mild (score < 2)	0	14	14	
	Total	9	21	30	

Fisher's exact test, s- significant

Diagnostic statistical analysis revealed sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) and accuracy of SIRS score in predicting severe acute pancreatitis was 100%, 77.8%, 63.6%, 100% and 84% respectively.

DISCUSSION

Acute pancreatitis is common in Pediatric Gastroenterology Department in Bangladesh. Predicting severity at the time of admission helps us for better evaluation and management. SIRS score may help us in distinguishing mild and severe acute pancreatitis patient.

In our study, more than half (50%) of the patients were >10 years' age followed by (33.33%) in the range of 5-10 years and 16.67% < 5 years. Similar results were found in a study done by Nydegger et al.,¹⁴ where 43.7% were in the range of 10–15-year, 31.9% within 5–10-year group and 24.4% were less than 5 years. The mean age of the children in the study was 10.35 ± 3.28 years which was also similar with a study conducted by Musabbir et al.,¹⁵ a few years back.

More than half (60%) of the children in the study were male. Nearly similar findings were found in a study done by Vitale et al.,¹⁶ where 62 out of 118 children were male. Slight female preponderance was noted in a study done by Galai et al.,¹⁷. So, gender is no independent risk factor for the severity and outcome of acute pancreatitis.¹⁸

In the present study, among 30 cases 70% were in mild group and 30% in severe group. There was no significant difference in terms of age between mild and severe AP group ($p=0.86$). Our consistent findings were observed in a study done by Vitale et al.,¹⁹ where there was no

significant ($p=0.96$) difference in age group. But contradictory findings were found in a study done by Galai et al.,¹⁷ where there was statistically significant ($p=0.01$) difference in mean age among mild AP (13.8 years) and severe AP (8.3 years).

In our study, there was no statistically significant difference in WBC, serum creatinine, RBS and S. ALT value between mild and severe pancreatitis groups ($p > 0.05$). Similar findings were found with the studies done by Galai et al.,¹⁷ Vitale et al.,¹⁶ and Farrel et al.,²⁰.

S. calcium value was significantly ($p=0.001$) increased in mild AP (9.8 ± 0.67 mmol/l) than severe AP (10.4 ± 0.51 mmol/l) groups. Penag et al.,²¹ observed that patients with POF had significantly lower value of serum calcium than patients without persistent organ failure (POF) on admission (1.55 ± 0.36 mmol/L vs 2.11 ± 0.46 , $p < 0.001$). Decreased level of serum calcium was commonly seen in critical illness. Hypocalcemia may serve as a potential prognostic factor as it is more common in patients with severe form of acute pancreatitis.²¹

S. Lipase, S. amylase and BUN were not statistically significant ($p=0.67$, 0.57 and 0.27) in current study. Galai et al.,¹⁷ also reported that S. Lipase was not significant ($p=0.27$) like our study. Vitale et al.,¹⁶ also found no statistical significant difference in S. amylase level ($p=0.35$). But in their study, BUN was significantly different ($p=0.0007$) between mild AP and severe AP (10 mg/dl vs 20 mg/dl). Vitale et al.,¹⁶ reported that CRP has discriminating value between mild and severe AP but we did not find it statistically different ($p=0.220$) like Izquiereo et al.,²².

In our study, statistically significant difference was noted in pulse and respiratory rate; p value 0.0001 and 0.004, respectively. These two parameters also the part with SIRS which was believed to have some discriminating value alone or as a part in differentiating mild and severe AP. There was also significant difference in systolic and diastolic BP between these two group and p value was 0.007 and 0.003, respectively. Zheng et al.,²³ found statistical significant difference in temp (p=0.001), heart rate (p=0.029) but no significant difference (p=0.688) in respiratory rate in between mild and severe AP group.

SIRS score is very easy to calculate, requires only 4 criteria and only one is lab parameter ie, leukocyte count. In this study, from severe AP group SIRS (score ≥ 2) identified all 9(100%) as severe case and from mild AP group SIRS identified 7(33.3%) as severe AP. This significant (p=0.001) findings from this study we can say it is better and easy to identify severe cases by very simple SIRS scoring. On the other hand, from severe AP group, no case identified as mild (<2 score) by SIRS but 14 (66.7%) case from mild AP group 21(70%) identified as mild. In previous studies, SIRS was found to be a good discriminating factor between mild AP and severe AP. Presence of SIRS found to be associated with persistent organ failure, pancreatic necrosis, increased hospital stay and ICU admission.^{13,24} SIRS (score ≥ 2) had sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV) in predicting severe acute pancreatitis was 100%, 77.8%, 63.6%, 100%, respectively.

CONCLUSIONS

SIRS score showed the promising results in the study in case of assessing the severity of pancreatitis in paediatric age group. So, SIRS can easily identify severe cases at admission with simple three clinical and one laboratory parameter.

Limitations of the study: The small sample size was small. Data were during COVID-19 pandemic situation. Single center study scarcely represent the situation of the whole country.

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