



Early Predictors of Complicated Acute Gastroenteritis in Children: The Role of Inflammatory and Hematological Biomarkers

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Abstrak. Acute gastroenteritis (AGE) is a frequent source of morbidity in children, and can be a self-limited illness or result in significant dehydration, electrolyte abnormalities, and systemic complications. Clinically important to identify children who are at risk of complicated disease in a timely manner. Aim of this study to assess the predictive capacity of some inflammatory-, hematological- and biochemical markers for early recognition of complicated AGE in children. A prospective analytical study was done from April 2024 to April 2025 in children aged 6 months to 5 years with AGE (n = 120). There were an equal number of uncomplicated (60) and complicated (60) AGE groups. Assessment of clinical characteristics, complete blood count, neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR), C-reactive protein (CRP), erythrocyte sedimentation rate (ESR), serum sodium, potassium, urea, creatinine and stool examination results were done. Logistic regression and receiver operating characteristic (ROC) curve analyses were performed. The results showed that children with complicated AGE had significantly higher WBC, neutrophil, NLR, PLR, CRP, ESR, urea and creatinine levels as well as decreased levels of lymphocytes, sodium and potassium levels than those with uncomplicated AGE ($P < 0.05$). The NLR, the CRP level, leukocytosis, ESR, hyponatremia and urea level were independently associated with complicated AGE. The NLR and CRP had the highest discriminatory values with AUCs of 0.88 and 0.89, respectively. Although there is no clear consensus, inflammatory and hematological biomarkers (CRP and NLR) along with routine clinical and biochemical parameters may help identify children early who are at higher risk of complicated AGE and facilitate timely clinical management.

Keywords: Acute gastroenteritis; Children; C-reactive protein; Neutrophil-to-lymphocyte ratio; Dehydration.

1. Introduction

Acute gastroenteritis (AGE) is one of the most prevalent acute illnesses encountered by children and is a significant reason for healthcare-seeking by children in the ED, hospitalization and preventable morbidity in the world. Mainly characterized by acute diarrhea, sometimes accompanied by vomiting, fever and abdominal symptoms. While most episodes are self-limited, some children become severely dehydrated, develop electrolyte and/or renal abnormalities, or manifest with additional systemic symptoms and require hospital and intensive care management [1], [2].

Determination of the severity of the disease in children with AGE may sometimes be difficult, especially at the beginning of the disease. Rapid water loss poses a particular threat to young children due to their high water needs and the small margins for error in the body's ability to tolerate water loss. Laboratory parameters should be used in conjunction with the clinical assessment of dehydration, although clinical assessment is the mainstay of the diagnosis and should not be ignored if the degree of fluid loss or systemic involvement is unclear [3], [4].



There has been growing interest in the use of inflammatory biomarkers as a way to diagnose children with more severe gastrointestinal infection. The levels of C-reactive protein (CRP), white blood cells, neutrophils, and erythrocyte sedimentation rate have been linked to inflammatory activity and, in a few studies, to bacteria or more clinically important forms of acute diarrhea [5], [6]. Derived hematological indices like neutrophil to lymphocyte ratio (NLR) could be a cost-effective and easily accessible system inflammatory response parameter, as it reflects the combined changes in the number of circulating neutrophils and lymphocytes. Recent studies have shown that inflammatory markers like C-reactive protein (CRP) and parameters related to leukocytes may be clinically useful in children who present with acute gastroenteritis [7].

Biochemical abnormalities can also be a result of complicated AGE's physiological effects. High urea and creatinine can often be associated with high volume losses and low renal blood flow, and disorders of serum sodium and potassium can result from gastrointestinal losses and alterations in fluid replacement [8]. So, there may be a more complete way to stratify early risk using a combination of clinical assessment, inflammatory, hematological and biochemical markers. The aim of the present study was to assess the usefulness of inflammatory and hematological markers, other biochemical parameters and the use of logistic regression and ROC curve analysis for predicting complicated acute gastroenteritis of children and to evaluate their diagnostic performance.

2. Research Methodology

Study Design and Setting

This study is a prospective analytical study carried out in the hospital setting to explore the utility of inflammatory and hematological markers in predicting complicated acute gastroenteritis (AGE) in children. The study was conducted in the pediatric departments and emergency units of Tikrit Teaching Hospital and Salah Al-Din General Hospital in April 2024 to April 2025 in Iraq. A total of 120 children with clinical signs suggestive of an acute gastroenteritis were included in the study.

Study Population and Study Groups

During the study period, 120 children aged 6 months to 5 years with acute gastroenteritis (AGI) according to the diagnostic criteria were enrolled. The children with AGE were divided into two equal groups based on clinical presentation and severity as Group I (uncomplicated AGE) 60 children and Group II (complicated AGE) 60 children. The uncomplicated group consisted of children with acute gastroenteritis who did not have any complications clinically significant and treated with routine supportive treatment.

Moderate to severe dehydration, persistent vomiting, electrolyte imbalance, bloody diarrhea, marked systemic reaction, and clinical condition requiring hospital admission and increased medical management were among the various clinically significant complications observed in children, and this complicated group was included. This classification allowed the comparative analysis of the hematological, inflammatory and biochemical parameters and their role as early markers of complicated AGE.

Clinical Assessment and Sample Collection

Demographic and clinical parameters were collected at enrolling time such as age, sex, episode of diarrhea duration, stool frequency, vomiting, fever, abdominal pain, hospitalization history, degree of dehydration and body weight. A thorough physical examination was carried out, highlighting the vital signs, hydration status, capillary refill, level of consciousness and systemic involvement. Venous blood samples were taken at admission prior to major intravenous therapy. Venous blood was collected about 3-5 mL in aseptic condition. The EDTA tube blood sample was analyzed for complete blood count (CBC) while the blood sample collected in plain tubes was allowed to clot in the tubes and centrifuged to obtain serum for biochemical and inflammatory marker assessment.



Hematological and Inflammatory Biomarkers

Hematological parameters measured were hemoglobin concentration, total white blood cell count, the count of neutrophils, lymphocytes, platelets, and red blood cell indexes. The complete blood count (CBC) was used to calculate inflammatory indices as potential markers for systemic inflammatory response, including the neutrophil-to-lymphocyte ratio (NLR) and platelet-to-lymphocyte ratio (PLR). The inflammatory biomarkers in the serum were C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR). To check for dehydration associated electrolyte and renal disturbances, serum biochemical investigations were performed including serum sodium, potassium, urea and creatinine. Stool exam was carried out to look for signs of intestinal infection (such as blood—either hidden or visible, or leukocytes or parasites or other infections signs) where clinically indicated.

Laboratory Procedures and Equipment

CBC parameters were measured using automated hematology analyzer and serum CRP using a validated immunoturbidimetric or other automated biochemical assay as per the manufacturer's instructions. The Westergren method was used to measure ESR. The automated electrolyte analyzer and the standard biochemical methods (enzymic and colorimetric) were used for the analysis of serum electrolytes and serum urea and creatinine respectively. Commercial reagents and in-house quality control were used for all laboratory analyses, following the manufacturer's instructions. The severity was evaluated according to the specific clinical criteria and all the laboratory findings were evaluated in the context of the child's clinical presentation.

Statistical Analysis

IBM SPSS Statistics version 27 was used for analyzing the data. Mean $\pm$ SD and median (IQR) were used to report continuous variables and frequencies and percentages were used to report categorical variables. Independent-samples t test, Mann–Whitney U test was used for continuous variables and chi-square test or Fisher's exact test was used for categorical variables to test differences between complicated and uncomplicated AGE groups. Independent predictors of complicated AGE were determined by binary logistic regression. Significant biomarkers were analyzed for their diagnostic/predictive performance and optimum cut-off value by receiver operating characteristic (ROC) curve analysis. A P value less than 0.05 was regarded as being statistically significant.

3. Result and Discussion

Result

The demographic variables of the subjects are presented in table 1. The mean age of the children with uncomplicated AGE was 2.41 ± 1.28 years, and the complicated AGE was 2.56 ± 1.31 years, respectively, with no statistically significant difference. Moreover, there were no significant differences in sex distribution between the two groups, which made it unlikely that age and sex would explain the differences in disease severity.

Table 1. Demographic characteristics of children with uncomplicated and complicated acute gastroenteritis

Variable	Uncomplicated AGE (n=60)	Complicated AGE (n=60)	P-value
Age (years), mean $\pm$ SD	2.41 ± 1.28	2.56 ± 1.31	0.518
Age 6–12 months, n (%)	13 (21.7)	11 (18.3)	0.657
Age 1–3 years, n (%)	28 (46.7)	27 (45.0)	0.862
Age >3–5 years, n (%)	19 (31.7)	22 (36.7)	0.560
Male, n (%)	33 (55.0)	35 (58.3)	0.716
Female, n (%)	27 (45.0)	25 (41.7)	



The clinical severity of children with complicated AGE was significantly higher than of children with uncomplicated AGE (Table 2). The duration of diarrhea was significantly longer in the complicated group, as was the stool frequency, vomiting frequency, and frequency of fever, and the prevalence of moderate to severe dehydration was significantly higher in the complicated group. Complicated cases also had significantly bloodier diarrhea and systemic signs.

Table 2. Clinical characteristics and manifestations of acute gastroenteritis

Clinical variable	Uncomplicated AGE (n=60)	Complicated AGE (n=60)	P- value
Duration of diarrhea (days), mean ± SD	3.2 ± 1.1	5.1 ± 1.7	<0.001
Stool frequency/day, mean ± SD	5.1 ± 1.5	8.2 ± 2.4	<0.001
Vomiting, n (%)	29 (48.3)	46 (76.7)	0.002
Fever, n (%)	25 (41.7)	44 (73.3)	0.001
Abdominal pain, n (%)	18 (30.0)	29 (48.3)	0.040
Mild dehydration, n (%)	38 (63.3)	12 (20.0)	<0.001
Moderate dehydration, n (%)	22 (36.7)	35 (58.3)	0.018
Severe dehydration, n (%)	0 (0.0)	13 (21.7)	<0.001
Bloody diarrhea, n (%)	3 (5.0)	15 (25.0)	0.002
Marked systemic manifestations, n (%)	2 (3.3)	17 (28.3)	<0.001
Hospital admission, n (%)	8 (13.3)	48 (80.0)	<0.001

Results of hematologic studies are summarized in Table 3. The complicated AGE had significantly higher levels of WBCs and neutrophils and significantly lower levels of lymphocytes than the uncomplicated group. Blood counts of platelets were also significantly high in complicated cases. There were no significant differences between the groups with regard to hemoglobin concentration and red blood cell indices.

Table 3. Hematological parameters among children with uncomplicated and complicated AGE

Hematological parameter	Uncomplicated AGE (n=60)	Complicated AGE (n=60)	P-value
Hemoglobin (g/dL)	11.7 ± 1.1	11.5 ± 1.2	0.327
WBC (×10 ⁹ /L)	9.18 ± 2.61	14.26 ± 4.18	<0.001
Neutrophils (×10 ⁹ /L)	4.82 ± 1.74	9.21 ± 3.48	<0.001
Lymphocytes (×10 ⁹ /L)	3.52 ± 1.21	2.61 ± 1.08	<0.001
Platelets (×10 ⁹ /L)	298.4 ± 69.7	351.6 ± 92.4	<0.001
MCV (fL)	75.8 ± 5.9	75.1 ± 6.2	0.536
MCH (pg)	26.1 ± 2.2	25.8 ± 2.3	0.464
MCHC (g/dL)	33.9 ± 1.1	33.7 ± 1.2	0.342

There was a significant difference between the two groups regarding the inflammatory profile (Table 4). CRP and ESR were significantly higher in children with complicated AGE. Moreover, complicated cases had significantly higher NLR and PLR, suggesting greater systemic inflammatory response. Of these parameters, the most significant difference between the two groups was found in NLR.

**Table 4.** Inflammatory biomarkers and derived inflammatory indices

Parameter	Uncomplicated AGE (n=60)	Complicated AGE (n=60)	P-value
CRP (mg/L), mean $\pm$ SD	12.8 $\pm$ 8.7	48.6 $\pm$ 28.9	<0.001
ESR (mm/h), mean $\pm$ SD	15.2 $\pm$ 6.1	31.8 $\pm$ 12.4	<0.001
NLR, mean $\pm$ SD	1.48 $\pm$ 0.62	3.82 $\pm$ 1.74	<0.001
PLR, mean $\pm$ SD	86.7 $\pm$ 25.4	141.8 $\pm$ 49.6	<0.001

The biochemical results are shown in Table 5. Children with complicated AGE had significantly lower levels of serum sodium and potassium indicating increased incidence of clinically significant electrolyte disturbance in this group. The levels of serum urea and serum creatinine were significantly higher in complicated cases, which indicates higher relative dehydration and less renal perfusion.

Table 5. Biochemical parameters in uncomplicated and complicated AGE

Biochemical parameter	Uncomplicated AGE (n=60)	Complicated AGE (n=60)	P-value
Sodium (mmol/L)	136.8 $\pm$ 3.9	132.1 $\pm$ 5.7	<0.001
Potassium (mmol/L)	4.12 $\pm$ 0.48	3.71 $\pm$ 0.62	<0.001
Urea (mg/dL)	25.6 $\pm$ 8.1	39.8 $\pm$ 14.7	<0.001
Creatinine (mg/dL)	0.43 $\pm$ 0.12	0.61 $\pm$ 0.19	<0.001

The results of stool examinations are summarized in Table 6. Evidence of inflammatory intestinal involvement was more frequent among children with complicated AGE. The presence of fecal leukocytes and blood (visible/occult) was significantly higher in the complicated group while the presence of parasitic elements did not differ significantly between groups.

Table 6. Stool examination findings among study participants

Stool finding	Uncomplicated AGE (n=60)	Complicated AGE (n=60)	P-value
Fecal leukocytes, n (%)	9 (15.0)	27 (45.0)	<0.001
Occult/visible blood, n (%)	5 (8.3)	18 (30.0)	0.003
Parasitic elements, n (%)	7 (11.7)	10 (16.7)	0.435
No significant abnormality, n (%)	43 (71.7)	24 (40.0)	0.001

The variables that showed an association with complicated AGE in the univariate analysis were added to the multivariable logistic regression model. Table 7 shows that elevated CRP, increasing NLR, increasing WBC count and moderate-to-severe dehydration were independent risk factors for complicated AGE. Of the biomarkers investigated, NLR ≥ 3.0 had the strongest independent predictors of complicated disease and elevated CRP had a significant predicting effect.

Table 7. Multivariable logistic regression analysis of predictors of complicated acute gastroenteritis

Predictor	Adjusted OR	95% CI	P-value
WBC $>12 \times 10^9/L$	2.84	1.29–6.26	0.009
NLR ≥ 3.0	4.76	2.04–11.09	<0.001
CRP >20 mg/L	4.21	1.82–9.74	0.001
ESR >25 mm/h	2.67	1.18–6.04	0.018
Moderate-to-severe dehydration	5.38	2.32–12.47	<0.001
Hyponatremia (<135 mmol/L)	2.91	1.27–6.68	0.012
Urea >35 mg/dL	2.48	1.07–5.73	0.034

To assess the discriminating power of the main inflammatory and hematological biomarkers in complicated versus uncomplicated AGE, ROC curve analysis was carried out. NLR and CRP had the best discriminatory performance as seen in Table 8. An NLR cut-off of about 2.85 gave a good sensitivity and specificity, and similarly good predictive performance was provided by CRP. WBC and ESR moderately discriminated (Fig. 1).

Table 8. Diagnostic performance of selected biomarkers for predicting complicated AGE

Biomarker	Optimal cut-off	AUC	Sensitivity (%)	Specificity (%)	P-value
WBC	$>11.8 \times 10^9/L$	0.78	75.0	71.7	<0.001
Neutrophils	$>7.1 \times 10^9/L$	0.82	78.3	75.0	<0.001
NLR	>2.85	0.88	83.3	81.7	<0.001
Platelets	$>325 \times 10^9/L$	0.69	65.0	66.7	0.001
CRP	$>20 \text{ mg/L}$	0.89	85.0	80.0	<0.001
ESR	$>24 \text{ mm/h}$	0.81	76.7	75.0	<0.001
PLR	>112	0.76	73.3	70.0	<0.001
Sodium	$<134 \text{ mmol/L}$	0.74	70.0	68.3	<0.001
Urea	$>34 \text{ mg/dL}$	0.77	71.7	73.3	<0.001

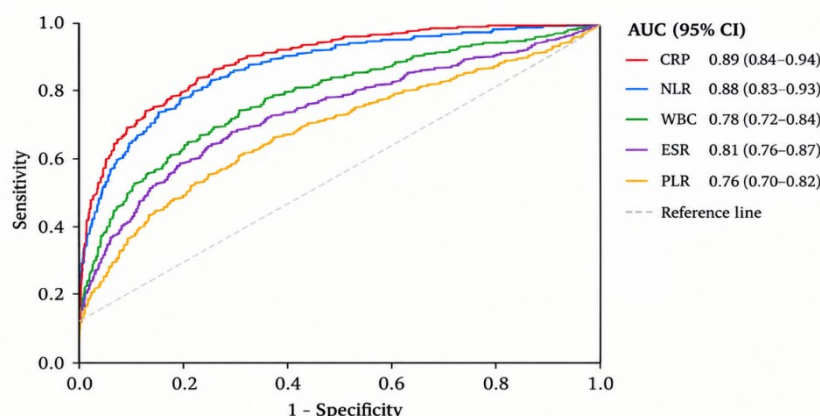


Figure 1. Receiver operating characteristic (ROC) curves of selected biomarkers for predicting complicated acute gastroenteritis. The figure should display ROC curves for CRP, NLR, WBC, ESR, and PLR, with CRP and NLR showing the largest areas under the curve.

Discussion

The present study showed that there were significant differences between children with uncomplicated and complicated acute gastroenteritis (AGE) in their clinical, hematological, inflammatory, and biochemical profiles. The main finding was a more severe systemic inflammatory response and more severe disturbances in electrolyte balance and hydration in complicated AGE. In particular, higher numbers of white blood cells, neutrophils, and neutrophils to lymphocytes (NLR) and lymphocytes to platelets (PLR) ratios, as well as higher levels of C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) and lower levels of serum sodium and potassium, and urea and creatinine were significantly associated with complicated disease. They confirm that common laboratory parameters could be useful for early risk stratification in children with AGE.

The difference was not significant when age and sex were analyzed in the present study, indicating that the differences in laboratory and clinical parameters were not associated with the difference in age and sex but rather associated with the severity of the disease. This is in line with previous pediatric studies where demographic factors were not consistently associated with severity of dehydration or disease. In a prospective study, involving 200 children with AGE, the authors Hoxha et al. did not find any significant association between dehydration severity with age or sex, but they did find a higher association between diarrhea and severe dehydration [9]. This supports the idea that clinical burden and physiological consequences of AGE are more useful than the demographics for making a determination of the severity.



Our study of the complicated group was found to have a significantly longer duration of diarrhea, more stool frequency, more vomiting and fever, and a significantly higher proportion of moderate-to-severe dehydration. This is clinically reasonable because as gastrointestinal fluid losses continue, especially in conjunction with vomiting and poor fluid replacement, intravascular volume and electrolyte is lost and normalized over time. Evidence has been provided in past studies that clinical assessment of dehydration is highly predictive of interventions in pediatric AGE. Goldman et al. have validated the Clinical Dehydration Scale in young children, and demonstrated that worsening dehydration severity was correlated with longer Emergency Department (ED) length of stay and the need for intravenous fluid therapy [10]. Likewise, Parkin et al. showed that clinical and laboratory parameters have the potential to help identify children with more severe dehydration [11]. Therefore, the increased dehydration status in our complex population emphasizes the need to use a combination of clinical assessment and objective laboratory parameters.

In the present research, significant rise in NLR and PLR was recorded amongst the complicated AGE children. NLR combines neutrophil predominance with relative reduction in the number of lymphocytes, which are two aspects of the systemic inflammatory response. It is noteworthy that its raised levels could represent a more comprehensive picture of inflammatory stress than cell count alone. While not specific to AGE, NLR can be elevated by several acute inflammatory diseases, it is inexpensive, and derived from a routine complete blood count making it appealing for initial screening in pediatric risk assessment. This was confirmed in the current ROC analysis which showed an NLR cut-off around 2.85 with an AUC of 0.88. This indicates good discrimination for complicated/complicated and uncomplicated/complicated disease among our subjects. However, this cutoff should be considered a population-specific one until it is validated prospectively in larger pediatric study populations.

One of the most significant results of our study was the increase in CRP. There was a significantly higher level of CRP in children with complicated AGE compared to those with uncomplicated disease, and significant ROC analysis of the CRP levels had an AUC of 0.89. This is consistent with previous evidence to show the utility of CRP in assessing inflammatory activity of gastrointestinal infections in children. In one study of acute gastrointestinal infections, there was significant difference between bacterial and viral or nonspecific gastroenteritis and CRP demonstrated useful discriminatory performance [14]. More recently, Alhazmi et al. [15] indicated that CRP was often elevated in pediatric AGE, and that it correlated with characteristics of clinical management such as antibiotic use, supporting its use as a marker of clinically significant inflammatory activity. The results of our study are therefore complimentary to the previous observations, suggesting that CRP may also be useful to identify children with a higher risk for a complicated clinical course at an early stage.

There was also a high ESR in complicated AGE which further supports enhanced inflammatory response. But ESR takes longer to be affected than CRP and may be affected by a number of non-inflammatory factors. Therefore, the use of ESR in conjunction with other more quickly responsive markers like CRP and hematological indices could be more informative clinically. Moreover, the association of elevated levels of both CRP and ESR in our complex group is consistent with previous pediatric studies which demonstrated that inflammatory markers were increased in more inflammatory types of gastrointestinal infection [16].

The biochemical results once again further supported the higher degree of physiological disturbance of complicated AGE. The values of serum sodium and potassium were significantly lower, while urea and creatinine were significantly higher in the complicated group. The rise of urea and creatinine is especially significant for the level of volume depletion and renal vasoconstriction. Hoxha et al. reported that urea and creatinine proved to be most useful in the case of severe dehydration as they were very specific for severe dehydration, but were less useful in differentiating between mild and moderate dehydration [9]. The severity of dehydration, similarly, was shown to be significantly related to the blood urea concentration in dehydrated children with AGE in a study [17]. These results are well consistent with our clinical observation where elevated urea levels and creatinine levels was associated with the more severe clinical phenotype.



Another clinical important finding is the low serum sodium level seen in complicated cases. In pediatric AGE, dysmetria is an easily recognized finding, and can be caused by either gastrointestinal losses of sodium, inadequate replacement, excessive free water consumption, or an increase in non-osmotic antidiuretic hormone production, which may occur with vomiting and dehydration. A prospective study of children admitted to hospital for AGE revealed that hyponatremia was present at admission in relatively few children, and other studies have highlighted the inter-dependent relationship between gastroenteritis, dehydration, hydration and serum sodium level. In addition, recently Chaiyapak et al. studied the prevalence and etiology of dysmetria in children with acute gastritis/gastroenteritis, and found that abnormalities in serum sodium continue to be a significant clinical problem in children with acute gastritis/gastroenteritis [18]. Thus, the correlation between low Na levels and complicated AGE in our study could be due to the increased fluid and electrolyte imbalance rather than a direct effect of the disease.

The multivariable logistic regression analysis is an important strength of the present study as several variables were found to be independently associated with complicated AGE after adjustment. There was a strong clinical association with moderate to severe dehydration, increased NLR, elevated CRP, leukocytosis, elevation of ESR, hyponatremia, and increase in urea. This pattern suggests that there is a need to identify and monitor a range of biomarkers for complicated AGE. Instead, a composite score of clinical dehydration evaluation and hematological, inflammatory and biochemical parameters is more representative of disease severity. This is in keeping with the findings that laboratory tests can be useful in conjunction with clinical evaluation if the level of dehydration or systemic involvement is unclear [9]. Furthermore, the ROC analysis highlighted the possible clinical significance of CRP and NLR. The AUC for CRP was 0.89, and for NLR was 0.88, signifying good discrimination. The sensitivity and specificity achieved at the recommended thresholds are quite high, which may make them useful for inclusion in an early-risk stratification strategy, especially in areas where more sophisticated biomarkers are not available. This matters in clinical settings where resources are limited as both CRP and NLR can be easily and quickly attained without the need for sophisticated technology beyond standard laboratory setups [21]. However, the use of them must be taken as a complement to the clinical evaluation.

The present findings also have implications for the care of children in the emergency room. When a child has repeated diarrhea and vomiting, they can look clinically well, but have laboratory evidence of significant inflammatory features (neutrophilia, high NLR, elevated CRP, early renal and electrolyte disturbance) and a more serious phenotype. Early recognition of such patients may help to better monitor, hydrate, lab re-evaluate and more carefully consider hospitalization options. Importantly, inflammatory markers should not be used as a universal sign to indicate the need for antibiotic treatment as an increase in CRP and leukocytosis is a sign of inflammatory activity and does not provide specific information about the cause in itself. Pediatric literature in recent years also backs up the use of inflammatory parameters as aids to clinical assessment, not as the sole basis for deciding antimicrobial therapy.

4. Conclusion

In the present study, it was found that complicated acute gastroenteritis (AGIE) in children is associated to a specific pattern of increased systemic inflammation, hematological changes, dehydration and biochemical disturbance. Higher levels of WBC, neutrophils, NLR, PLR, CRP and ESR, hyponatremia, and higher urea and creatinine levels were significantly related to complicated disease. The best markers discriminatory performance was observed for CRP (AUC value = 0.89) and NLR (AUC value = 0.88) among the markers studied. Multivariable analysis confirmed that moderate to severe dehydration, NLR, CRP and leukocytosis were important independent factors. These results suggest that simple clinical and laboratory data routinely collected in the clinic can be useful as early risk stratification in the pediatric AGE population. These combined tests may improve the ability of clinicians to detect patients at risk at an earlier stage of the disease, optimize monitoring and fluid management and assess the need for hospitalization. However, larger prospective, multicenter studies are needed to confirm the proposed cut-off values and to determine their generalizability.



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