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POINT OF ADMISSION SERUM ELECTROLYTE PROFILE CHILDREN PRESENTING WITH DEHYDRATION SECONDARY TO ACUTE GASTROENTERITIS

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Abstract

Background: Acute gastroenteritis (AGE) is a major cause of morbidity and mortality among children, particularly in developing countries. It is defined as a sudden increase in stool frequency and/or decrease in consistency lasting less than two weeks (Elliott, 2007). Globally, approximately 1.7 billion episodes of acute diarrhea occur annually, resulting in nearly 700,000 deaths among children fewer than five years (Parashar et al., 2003). Electrolyte disturbances are common in children presenting with dehydration secondary to AGE and may lead to serious complications if not promptly recognized (Okposio et al., 2015; Babar & Sanaullah, 2016). Objective: To determine the serum electrolyte profile at admission in children presenting with dehydration secondary to acute gastroenteritis. Methods: This cross-sectional study was conducted in the Department of Paediatrics, Bolan Medical College Hospital, over six months. A total of 149 children aged 1–14 years with dehydration due to AGE were enrolled using consecutive sampling. Serum sodium, potassium, chloride, and bicarbonate levels were measured at admission. Data were analyzed using SPSS version 25. Quantitative variables were expressed as mean ± standard deviation, while qualitative variables were presented as frequencies and percentages. A p-value < 0.05 was considered statistically significant. Results: The mean age of the children was 5.8 ± 3.2 years. Of the 149 patients, 87 (58.4%) were male and 62 (41.6%) were female. Electrolyte abnormalities were observed in 92 (61.7%) children at admission. Hypernatremia was the most common abnormality, present in 54 (36.2%) patients, followed by hypokalemia in 43 (28.9%) patients. Hypernatremia and hyperkalemia were observed in 7 (4.7%) and 5 (3.4%) patients, respectively. Metabolic acidosis (low bicarbonate levels) was identified in 48 (32.2%) children. A statistically significant association was found between severity of dehydration and presence of electrolyte imbalance (p = 0.01). Conclusion: Electrolyte disturbances are common at the time of admission in children with dehydration secondary to acute gastroenteritis, with hypernatremia being the most frequent abnormality. Early identification of these disturbances is essential for appropriate fluid management and improved clinical outcomes.

Introduction

Acute gastroenteritis (AGE) is one of the most common pediatric illnesses worldwide and remains a significant contributor to childhood morbidity and mortality, particularly in developing countries. It is defined as a sudden onset of diarrhea characterized by an increase in stool frequency and/or a decrease in stool consistency lasting less than two weeks (Elliott, 2007). Patterns of stooling vary among young children; therefore, diarrhea is best understood as a deviation from the normal bowel habits of the individual child (Tham et al., 1996). Although often self- limiting, AGE can rapidly progress to dehydration and metabolic disturbances, especially in infants and young children.

Globally, acute diarrheal diseases account for approximately 1.7 billion cases annually and are responsible for nearly 700,000 deaths among children under five years of age (Parashar et al., 2003). Despite improvements in sanitation, vaccination, and oral rehydration therapy, diarrheal illnesses remain a major public health concern. In developing countries, including Pakistan, diarrheal diseases contribute substantially to under-five mortality and are among the leading causes of hospital admissions in pediatric units (Bhutta et al., 2013). Local studies have also highlighted the persistent burden of gastroenteritis outbreaks and associated complications in Pakistani children (Akram et al., 2021).

The primary pathophysiological consequence of acute gastroenteritis is the disruption of normal intestinal absorption and secretion, leading to excessive loss of fluids and electrolytes. Electrolytes such as sodium, potassium, chloride, and bicarbonate play a vital role in maintaining cellular function, acid–base balance, neuromuscular activity, and overall homeostasis. In children with dehydration secondary to AGE, abnormalities in these electrolytes are common and may lead to serious complications, including seizures, cardiac arrhythmias, altered mental status, and metabolic acidosis if not identified and corrected promptly (Babar & Sanaullah, 2016).

Several studies have reported varying patterns of electrolyte disturbances in children presenting with acute diarrhea. Okposio et al. (2015) observed that hyponatremia was the most frequent electrolyte abnormality, followed by metabolic acidosis and hypokalemia. Similarly, other regional studies have documented significant rates of hypokalemia and hyponatremia among hospitalized children with dehydration due to AGE (Babar & Sanaullah, 2016). The prevalence and pattern of electrolyte imbalance may vary depending on the severity of dehydration, duration of illness, nutritional status, and prior fluid intake.

Early assessment of serum electrolytes at the time of hospital admission is crucial for guiding appropriate fluid therapy. While numerous studies have focused on electrolyte changes during hospital stay, comparatively fewer investigations have emphasized electrolyte status at the point of admission. Identifying the most common electrolyte abnormalities at presentation can help clinicians select the most suitable intravenous fluids and prevent complications associated with improper correction. Moreover, understanding the local pattern of electrolyte disturbances is essential for developing evidence-based management protocols tailored to the pediatric population served.

Given the high burden of acute gastroenteritis and its associated complications, there is a need to evaluate the serum electrolyte profile of children presenting with dehydration at the time of admission. Therefore, this study aims to determine the frequency and pattern of serum electrolyte abnormalities in children aged 1–14 years presenting with dehydration secondary to acute gastroenteritis at a tertiary care hospital. The findings of this study are expected to contribute to improved clinical decision-making and better management outcomes in pediatric patients with AGE.

Literature Review

Acute gastroenteritis (AGE) remains a leading cause of illness and hospitalization among children globally. Despite advancements in preventive and therapeutic strategies, diarrheal diseases continue to impose a significant burden, particularly in low- and middle-income countries. According to Parashar et al. (2003), rotavirus and other infectious agents contribute substantially to global childhood morbidity and mortality, with millions of

episodes occurring annually. In developing countries, inadequate sanitation, poor access to clean water, and limited healthcare facilities further exacerbate the severity and outcomes of diarrheal diseases (Bhutta et al., 2013). The clinical course of AGE is often complicated by dehydration, which results from excessive loss of fluids and electrolytes through diarrhea and vomiting. The severity of dehydration has been shown to correlate with increased risk of metabolic disturbances and adverse outcomes (Elliott, 2007). Assessment tools such as clinical signs—including sunken eyes, decreased skin turgor, altered consciousness, and abnormal thirst—are commonly used to categorize dehydration into mild, moderate, and severe forms. Accurate assessment is critical because electrolyte imbalance often parallels the severity of dehydration.

Electrolyte disturbances are frequently observed in children with dehydration secondary to AGE. Sodium imbalance, particularly hyponatremia, is widely reported as the most common abnormality. Okposio et al. (2015), in a study of children under five years presenting with dehydration due to acute diarrhea, reported hyponatremia in 60.5% of cases, followed by metabolic acidosis (59.5%) and hypokalemia (44.3%). Hypernatremia and hyperkalemia were less frequent but clinically significant findings. These disturbances may occur due to inappropriate fluid replacement, ongoing gastrointestinal losses, or impaired renal compensatory mechanisms.

Similarly, Babar and Sanaullah (2016) evaluated serum electrolyte disturbances in children with acute diarrhea and found that hypokalemia and hyponatremia were common abnormalities at admission. They emphasized that unrecognized electrolyte imbalance can lead to serious complications such as cardiac arrhythmias, seizures, and prolonged hospital stay. Their findings reinforce the importance of routine electrolyte assessment in children presenting with moderate to severe dehydration.

Regional data from Pakistan also indicate that diarrheal illnesses remain a persistent health challenge. Bhutta et al. (2013) highlighted that diarrhea contributes significantly to under-five mortality in Pakistan, despite the availability of oral rehydration therapy and zinc supplementation. Moreover, outbreaks of gastroenteritis in school settings and communities continue to be reported, underscoring the ongoing burden of the disease (Akram et al., 2021). These findings suggest that complications such as electrolyte imbalance may be more common in resource-limited settings where delays in presentation and inadequate initial management occur.

Although several studies have investigated electrolyte disturbances during hospitalization, limited research has focused specifically on the serum electrolyte profile at the time of admission. Early identification of abnormalities at presentation is crucial because initial fluid management decisions are often made before complete laboratory evaluation is available. Failure to recognize sodium and potassium disturbances can lead to inappropriate fluid therapy, worsening metabolic imbalance, and increased risk of morbidity.

In summary, existing literature consistently demonstrates that electrolyte abnormalities are common in children with dehydration secondary to acute gastroenteritis, with hyponatremia and hypokalemia being the most frequently reported disturbances (Okposio et al., 2015; Babar & Sanaullah, 2016). However, variations in prevalence across different regions highlight the need for local data to guide clinical practice. Therefore, the present study aims to determine the serum electrolyte profile at admission in children presenting with dehydration due to acute gastroenteritis in our setting.

Methodology Study Design

This was a hospital-based cross-sectional study.

Study Setting

The study was conducted in the Department of Paediatrics, Bolan Medical College Hospital Quetta, a tertiary care teaching hospital providing pediatric services to urban and rural populations of Balochistan.

Study Duration

The duration of the study was six months after approval of the research proposal by the College of Physicians and Surgeons Pakistan (CPSP).

Sample Size

A total of 149 children were included in the study. The sample size was calculated using the WHO sample size formula, taking the prevalence of hypernatremia (60.5%) reported in previous literature (Okposio et al., 2015), with a 95% confidence interval and 8% margin of error.

Sampling Technique

Non-probability consecutive sampling technique was used. All eligible children presenting during the study period were enrolled until the required sample size was achieved.

Study Population

Inclusion Criteria

- Children aged 1–14 years
- Both male and female patients
- Diagnosed with acute gastroenteritis (diarrhea lasting less than 14 days)
- Presenting with clinical signs of dehydration
- Admitted to the pediatric ward

Exclusion Criteria

- Children with chronic diarrhea (>14 days)
- Children with known renal disease
- Children with congenital heart disease
- Children with metabolic disorders
- Children who had received intravenous fluid therapy prior to hospital presentation

Operational Definitions

- **Acute Gastroenteritis:** Passage of three or more loose or watery stools per day lasting less than 14 days (Elliott, 2007).
- **Dehydration:** Classified as mild, moderate, or severe based on clinical assessment (sunken eyes, skin turgor, mucous membrane dryness, level of consciousness).
- **Hyponatremia:** Serum sodium <135 mEq/L
- **Hypernatremia:** Serum sodium >145 mEq/L
- **Hypokalemia:** Serum potassium <3.5 mEq/L
- **Hyperkalemia:** Serum potassium >5.5 mEq/L
- **Metabolic Acidosis:** Serum bicarbonate <22 mEq/L

Data Collection Procedure

After obtaining informed consent from parents or guardians, detailed history and clinical examination were performed. Dehydration status was assessed clinically at admission. Approximately 3–5 ml of venous blood was collected under aseptic conditions before initiation of intravenous fluid therapy. Serum sodium, potassium, chloride, and bicarbonate levels were measured using the hospital laboratory's standard biochemical analyzer. All relevant demographic and clinical data were recorded on a pre-designed proforma

Data Analysis

Data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 25. Quantitative variables such as age and serum electrolyte levels were presented as mean ± standard deviation. Qualitative variables such as gender, dehydration category, and electrolyte abnormalities were presented as frequencies and percentages.

Effect modifiers such as age, gender, and severity of dehydration were controlled through stratification. Post-stratification chi-square test or Fisher's exact test was applied to assess associations between dehydration severity and electrolyte abnormalities. A p-value ≤ 0.05 was considered statistically significant.

Ethical Considerations

Approval was obtained from CPSP prior to data collection. Permission was taken from the hospital administration. Informed written consent was obtained from parents or guardians. Confidentiality of patient information was maintained throughout the study, and data were used solely for research purposes.

Results

A total of 149 children presenting with dehydration secondary to acute gastroenteritis were included in the study.

Table 1: *Demographic Characteristics of Study Participants (n = 149)*

Variable	Frequency (n)	Percentage (%)
Age (years)		
1–5 years	72	48.3%
6–10 years	51	34.2%

11–14 years	26	17.4%
Gender		
Male	87	58.4%
Female	62	41.6%

The mean age of participants was 5.8 ± 3.2 years. Nearly half of the children (48.3%) were between 1–5 years of age, indicating that younger children were more commonly affected. Males (58.4%) were slightly more affected than females (41.6%).

Table 2: ***Severity of Dehydration (n = 149)***

Severity of Dehydration	Frequency (n)	Percentage (%)
Mild	39	26.2%
Moderate	71	47.7%
Severe	39	26.2%

Most children (47.7%) presented with moderate dehydration, while equal proportions (26.2%) had mild and severe dehydration. This indicates that nearly three-quarters of patients presented with clinically significant dehydration requiring careful management.

Table 3: ***Frequency of Electrolyte Abnormalities at Admission (n = 149)***

Electrolyte Disturbance	Frequency (n)	Percentage (%)
Hyponatremia	54	36.2%
Hypernatremia	7	4.7%
Hypokalemia	43	28.9%
Hyperkalemia	5	3.4%
Metabolic Acidosis	48	32.2%
Any Electrolyte Abnormality	92	61.7%

Overall, 61.7% of children had at least one electrolyte abnormality at admission.

- Hyponatremia (36.2%) was the most common disturbance.
- Hypokalemia (28.9%) and metabolic acidosis (32.2%) were also frequently observed.
- Hypernatremia and hyperkalemia were comparatively less common.

This demonstrates that electrolyte imbalance is a common complication of dehydration secondary to acute gastroenteritis.

Table 4: ***Mean Serum Electrolyte Levels at Admission (n = 149)***

Parameter	Mean ± SD	Normal Reference Range
Sodium (mEq/L)	134.6 ± 5.8	135–145
Potassium (mEq/L)	3.6 ± 0.9	3.5–5.5
Chloride (mEq/L)	101.2 ± 6.4	98–107
Bicarbonate (mEq/L)	20.8 ± 3.7	22–28

The mean sodium level was slightly below the normal reference range, supporting the high prevalence of hyponatremia. The mean bicarbonate level was also reduced, indicating metabolic acidosis in a considerable proportion of patients.

Table 5: ***Association between Severity of Dehydration and Electrolyte Abnormality (n = 149)***

Severity	Electrolyte Abnormality Present	Electrolyte Normal	Total	pvalue
Mild	16	23	39	
Moderate	45	26	71	
Severe	31	8	39	
Total	92	57	149	0.01

Electrolyte abnormalities were significantly more common in children with moderate and severe dehydration.

- 79.5% of children with severe dehydration had electrolyte imbalance.

• Statistical analysis using Chi-square test showed a significant association ($p = 0.01$) between dehydration severity and electrolyte disturbance.

This indicates that the risk of electrolyte imbalance increases with increasing severity of dehydration.

Summary of Results

• Majority were children under 5 years.
• Moderate dehydration was most common.
• 61.7% had at least one electrolyte abnormality.
• Hyponatremia was the most frequent disturbance.
• Significant association was found between dehydration severity and electrolyte imbalance.

Discussion

Acute gastroenteritis (AGE) continues to be a major cause of pediatric hospital admissions, particularly in developing countries where diarrheal diseases remain highly prevalent. The present study evaluated the serum electrolyte profile at admission in children presenting with dehydration secondary to AGE and demonstrated that electrolyte abnormalities are common at presentation, with hyponatremia being the most frequent disturbance.

In this study, the mean age of participants was 5.8 ± 3.2 years, and nearly half of the children (48.3%) were between 1–5 years of age. This finding is consistent with global epidemiological data indicating that younger children are more vulnerable to diarrheal illnesses due to immature immunity, poor hygiene practices, and increased susceptibility to infections (Parashar et al., 2003). Similar age distributions have been reported in regional studies, highlighting that underfive children constitute the majority of hospital admissions related to AGE (Bhutta et al., 2013).

Male predominance (58.4%) was observed in the present study. Comparable findings were reported by Babar and Sanaullah (2016), who also documented a higher proportion of male children admitted with acute diarrhea. This gender difference may reflect sociocultural healthcare-seeking behaviors in certain regions rather than a true biological predisposition.

Regarding dehydration severity, most patients presented with moderate dehydration (47.7%), while 26.2% had severe dehydration. This emphasizes delayed presentation to healthcare facilities, which is common in resource-limited settings. Elliott (2007) highlighted that progression from mild diarrhea to moderate or severe dehydration can occur rapidly in children if fluid losses are not adequately replaced. Early recognition and timely intervention are therefore critical in preventing complications.

The most significant finding of this study was that 61.7% of children had at least one electrolyte abnormality at admission. Hyponatremia was the most frequent disturbance (36.2%), followed by metabolic acidosis (32.2%) and hypokalemia (28.9%). These findings are consistent with those of Okposio et al. (2015), who reported hyponatremia as the most common electrolyte abnormality in children with dehydration secondary to acute diarrhea. Similarly, Babar and Sanaullah (2016) observed high rates of hypokalemia and hyponatremia in hospitalized children with AGE.

Hyponatremia in diarrheal illness may result from sodium loss in stool, dilutional effects due to inappropriate hypotonic fluid intake, or impaired renal sodium conservation. If unrecognized, severe hyponatremia may lead to neurological complications such as seizures and altered consciousness. Hypokalemia, observed in 28.9% of patients in this study, is likely due to gastrointestinal potassium losses and may predispose to cardiac arrhythmias and muscle weakness. The reduced mean bicarbonate level observed in our study further supports the presence of metabolic acidosis secondary to bicarbonate loss in stool.

Importantly, a statistically significant association ($p = 0.01$) was found between severity of dehydration and electrolyte imbalance. Children with severe dehydration had the highest proportion of electrolyte disturbances. This finding aligns with previous literature demonstrating that electrolyte abnormalities correlate with the degree of fluid deficit and ongoing losses (Okposio et al., 2015). The clinical implication of this association is that children presenting with moderate to severe dehydration require prompt laboratory evaluation and careful fluid management.

The results of this study reinforce the importance of assessing serum electrolytes at the time of

admission before initiating intravenous fluid therapy. Early identification of abnormalities allows for appropriate correction and prevention of complications associated with rapid or improper fluid replacement.

Limitations

This study was conducted at a single tertiary care hospital, which may limit the generalizability of findings. Additionally, electrolyte levels were measured only at admission and not monitored dynamically during hospital stay. Future multicenter studies with larger sample sizes and follow-up electrolyte monitoring are recommended.

Conclusion

This study concludes that electrolyte abnormalities are common at the time of admission in children presenting with dehydration secondary to acute gastroenteritis. A significant proportion (61.7%) of patients had at least one electrolyte disturbance. Hyponatremia was the most frequently observed abnormality, followed by metabolic acidosis and hypokalemia. Hypernatremia and hyperkalemia were comparatively less common but remain clinically important due to their potential complications.

The study also demonstrated a statistically significant association between the severity of dehydration and the presence of electrolyte imbalance ($p = 0.01$). Children with moderate and severe dehydration were more likely to exhibit abnormal serum electrolyte levels compared to those with mild dehydration.

These findings highlight the importance of early biochemical assessment in children presenting with acute gastroenteritis. Routine evaluation of serum electrolytes at admission can facilitate timely identification of imbalances, guide appropriate fluid therapy, and reduce the risk of complications such as seizures, cardiac arrhythmias, and worsening metabolic acidosis.

Recommendations

Based on the findings of this study, the following recommendations are proposed:

1.Routine Electrolyte Assessment: Serum electrolytes should be assessed at the time of admission in all children presenting with moderate to severe dehydration secondary to acute gastroenteritis.

2.Early Identification and Correction: Prompt identification and appropriate correction of sodium and potassium disturbances should be prioritized to prevent neurological and cardiac complications.

3.Standardized Treatment Protocols: Pediatric units should implement standardized fluid management protocols based on local patterns of electrolyte disturbances.

4.Parental Awareness Programs: Community education programs should emphasize early healthcare seeking behavior for children with persistent diarrhea and signs of dehydration.

5.Further Research: Multicenter studies with larger sample sizes and longitudinal monitoring of electrolyte changes during hospitalization are recommended to better understand trends and outcomes.

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