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Original Research Article

A Hospital Based Observational Assessment of Electrolyte Abnormalities among Children Hospitalized Due to Gastroenteritis

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Abstract

Aim: The aim of the present study was to evaluate the electrolyte abnormalities in children with gastroenteritis.

Methods: It was an observational study conducted among children in the Department of Paediatrics , BMIMS, Pawapuri, with a sample size of 200 patients. The aim of this study is to determine the incidence of electrolyte abnormalities among gastroenteritis patients admitted over 1 year in the Department of Paediatrics. The protection of the privacy of the participants was ensured and no details were shared.

Results: Among the whole sample of 200 patients, it is seen that 120 patients, constituting 60% of the total, are male, while the remaining 80 patients, accounting for 40% of the total, are female. The sample size was partitioned into three distinct age categories: infants (<1 year) comprising 60% of the sample, pre-schoolers (1-7 years) comprising 30% of the sample, and older children (>7 years) including 10% of the population. The prevailing salt aberration seen in this research is hyponatremia, which was identified in 104 individuals, accounting for 52% of the total sample. A same pattern was seen in a cohort of preschool children, consisting of 60 patients. Of these patients, 92 (46%) exhibited hyponatremia, 76 (38%) displayed normonatremia, and 16 (8%) presented with hypernatremia. Consequently, it was observed that hyponatremia was the prevailing condition among infants and pre-school children in terms of age, followed by normonatremia and hypernatremia. The majority of older children initially had normal sodium levels, which were subsequently followed by the development of hyponatremia and, in some cases, hypernatremia.

Conclusion: Diarrhoea remains one of the major causes of death among infants. The major contributing factors for higher incidence and mortality rates are poor hygiene, unsafe drinking water, physiological conditions like malnutrition and weak immune system. Electrolyte abnormalities is the leading cause of morbidity and mortality. It is important to promptly identify and treat children who exhibit acute gastroenteritis together with electrolyte imbalances in order to mitigate the adverse health outcomes and fatalities associated with these conditions.

Keywords: Acute gastroenteritis, Electrolyte, Hyponatremia , Hypokalemia.

Introduction

Acute Gastroenteritis (AGE) is well recognized as a significant contributor to both illness and death rates among paediatric populations worldwide. [1,2] The user's text does not provide enough information to be rewritten academically. Every year, a significant number of cases of Acute Gastroenteritis (AGE) are recorded globally, ranging from 3 to 5 billion. This infectious disease is particularly concerning since it is believed to be the cause of over 2 million fatalities among children under the age of 5 years. [3] Approximately 10-20% of acute gastroenteritis (AGE) cases are attributed to bacterial infections, whereas viral etiology is believed to account for roughly 70% of AGE cases. Notably, rotavirus is well recognized as the predominant viral pathogen associated with acute gastroenteritis. [4,5] The implementation of the oral rehydration treatment (ORT) program by the World Health Organization (WHO) has resulted in a substantial reduction in death rates among children affected with acute gastroenteritis. [6] Some of the primary consequences of acute gastroenteritis are dehydration, electrolyte imbalances, and renal dysfunction.

Certain physicians argue that blood chemical analysis may not be necessary for children with acute gastroenteritis (AGE), but emphasize the

significance of assessing electrolyte imbalances in order to determine the degree of dehydration and the severity of the condition. The prompt and effective detection and treatment of dehydration may lead to the successful resolution of dehydration associated with acute gastroenteritis. [7] Acute watery diarrhea is a prominent contributor to both illness and death in children under the age of five, especially in nations located in sub-Saharan Africa. According to data provided by the World Health Organization (WHO) and the United Nations Children's Fund, there is a global annual incidence of approximately 2 billion cases of diarrheal diseases. This significant burden of disease results in the unfortunate demise of over 1.9 million children under the age of 5, which accounts for approximately 18% of all child deaths. It is important to note that these fatalities primarily occur in developing nations. [8]

Typically, there is a higher prevalence of electrolyte problems in younger children who have severe diarrhea. Dehydration is identified as the most significant danger associated with acute watery diarrheal illness. During a bout of diarrhea, the individual experiences a loss of water and electrolytes, including sodium, chloride, potassium, and bicarbonate, via various bodily excretions such as liquid stools, vomit, perspiration, urine, and respiration. [9] Furthermore, many pathophysiological processes, including as aberrant fluid and electrolyte transport, diminished absorption, and heightened secretion [10], may potentially be implicated in pediatric patients with severe diarrhea. Research has shown that electrolyte imbalances, namely hyponatremia, hypokalemia, and metabolic acidosis, are prevalent in children experiencing severe diarrhea and dehydration, and are often associated with death. [11-14] Moreover, hypokalemic acute kidney damage emerges as a noteworthy complication in pediatric patients admitted with severe acute watery diarrhea, leading to extended hospital stays and increased fatality rates. [15]

Hence, it is essential to determine the incidence and characteristics of complications associated with acute diarrheal illness, such as electrolyte imbalances and malnutrition, among younger children. This will enable the formulation of evidence-based guidelines aimed at preventing mortality. The aim of the current investigation was to assess the electrolyte imbalances seen in pediatric patients diagnosed with gastroenteritis.

Materials and Methods

It was a an observational study conducted in children in the Department of Pediatrics at BMIMS, Pawapuri, Nalanda, Bihar, India with a sample size of 200 patients. The aim of the study is to determine the incidence of electrolyte abnormalities among gastroenteritis patients admitted over 1 year. The protection of the privacy of the participants was ensured and no details were shared.

Inclusion Criteria

All gastroenteritis patients admitted in the Department of Paediatrics were included in the study.

Exclusion Criteria

Patients with other underlying disease with gastroenteritis starting during hospital stay were excluded from study.

Statistical Analysis

The collected data is entered into SPSS statistical software. The frequency command is used to determine the frequency of data.

Results

Table 1: Number and percentage of children in different age groups

Parameters		Frequency	Percentage (%)
Age (Years)	<1	120	60
	1-7	60	30
	>7	20	10
	Total	200	100.0
Gender			
Male		120	60
Female		80	40

Out of total 200 patients, 120 patients (60%) are males and 80 patients (40%) are females. The sample size was divided in three different age groups of infants (<1 year) 60%, pre-schoolers (1-7 years) 30% and older children (>7 years 10%.

Table 2: Percentages of patients with hyponatremia, hypernatremia and normal sodium levels of patients at the time of hospital admission

Sodium level	Frequency	Percentage (%)
Low	104	52
Normal	80	40
High	16	8
Total	200	100.0

The most common sodium abnormality encountered in this study is hyponatremia seen in 104 patients (52%).

Table 3: Sodium values with which children of different age groups presented to the hospital

Sodium values	Low	Normal	High
Age (years)			
<1	60 (30)	44 (22)	16 (8)
1-7	32 (16)	24 (12)	4 (2)
>7	0	8 (4)	12 (6)
Potassium values			
<1	8 (4)	110 (55)	2 (1)
1-7	12 (6)	48 (24)	0
>7	6 (3)	12 (6)	2 (1)

The similar trend was seen in preschool children (60 patients) with 92 patients (46%) hyponatremia, 76 patients (38%) with normo-natremia and 16 patients (8%) with hypernatremia. Therefore, on the basis of age, hyponatremia was found as a dominant finding in infants and pre-schoolers followed by normo-natremia and then hypernatremia. Older children mostly presented with normal sodium values followed by hyponatremia and then hypernatremia. In preschool children (120 patients), 170 patients (85%) presented with normokalaemia, 26 patients (13%) presented with hypokalaemia and there were 4 patients that presented with hyperkalaemia from preschool age group.

Table 4: Degree of dehydration and corresponding sodium levels

Degree of dehydration		Low	Normal	High
	N	22	18	0
Mild	%	55	45	0
	N	30	18	2
Moderate	%	60	36	4
	N	52	44	14
Severe	%	45.62	38.60	12.28
	N	104	80	16
Total	%	52	40	8

Sodium values were evaluated on the basis of different degrees of dehydration and the most common sodium abnormality found in all the three groups of mild, moderate and severe dehydration was hyponatremia. Among the mildly dehydrated patients (40 patients), 22 patients (55%) presented with hyponatremia followed by normal sodium values in 18 patients (45%). The same trend was seen in moderately dehydrated and severely dehydrated patients. In moderately dehydrated patients (50 patients), 30 patients (60%) presented with hyponatremia followed by normonatremia in 18 patients (36%) and then hypernatremia in 2 patients (4%). Among the severely dehydrated patients (114 patients), 52 patients (45.62%) presented with hyponatremia followed by normonatremia in 44 patients (38.60%) and hypernatremia in 14 patients (12.28%).

Table 5: Degree of dehydration and corresponding potassium levels

Degree of dehydration		Low	Normal	High
Mild	N	5	25	0
	%	16.66	83.34	0
Moderate	N	6	32	2
	%	15	80	5
Severe	N	9	119	2
	%	6.92	91.53	1.53
Total	N	20	176	4
	%	10	88	2

Potassium values were evaluated on the basis of degree of dehydration and the most common finding in all the groups was normokalaemia. In mildly dehydrated patients (30 patients), 25 patients (83.34%) presented with normokalaemia followed by hypokalaemia in 5 patients (16.66%). Among the moderately dehydrated patients (40 patients), 32 patients presented with normokalaemia followed by hypokalaemia in 6 patients (15%) and the hyperkalaemia in 2 patient (5%). In severely

dehydrated patients (132 patients), 119 patients (91.53%) presented with normokalaemia followed by hypokalaemia in 11 patients (6.92%) and then hyperkalaemia in 2 patients (1.53%).

Discussion

Acute gastroenteritis remains a significant contributor to both morbidity and death rates. Diarrhoea ranks as the second most prominent cause of avoidable morbidity in children below the age of five. [16,17] However, there seems to be a disparity in the distribution of risk variables across industrialized and developing nations. [18] Developing nations often have comparable risk factors associated with sanitation and poverty, hence rendering their people susceptible to diarrheal diseases. [19] Rotavirus is widely recognized as the primary etiological factor responsible for the occurrence of diarrhoea in infants and toddlers, both in economically advanced nations and in those with less resources. However, the occurrence of sickness in wealthy nations is often associated with factors such as seasonality, travel, and transmission via food. [20]

Among the sample of 200 patients, it is seen that 120 individuals (60%) are male, whereas 80 individuals (40%) are female. The sample population was stratified into three distinct age categories: newborns (<1 year) comprising 60% of the sample, pre-schoolers (1-7 years) comprising 30% of the sample, and older children (>7 years) including 10% of the sample. This observation aligns with the results of a research conducted in India, whereby the authors reported that 65% of acute diarrhea patients were identified as male. [21] The prevailing salt aberration seen in this research is hyponatremia, which was identified in 104 individuals, accounting for 52% of the total sample. A same pattern was seen in a cohort of preschool children, consisting of 60 patients. Within this group, 92 patients (46%) exhibited hyponatremia, 76 patients (38%) displayed normo-natremia, and 16 patients (8%) presented with hypernatremia. Consequently, the analysis revealed that hyponatremia was the prevailing observation among newborns and pre-school children in terms of age, followed by normonatremia and subsequently hypernatremia. The majority of older children first had normal sodium levels, which were subsequently followed by the occurrence of hyponatremia and hypernatremia. In our particular context, acute diarrheal disorders affecting children under the age of five have been linked to many causal factors, with rotavirus infections being the primary contributor to instances of severe dehydrating gastroenteritis. [22] The potential etiology of acute gastroenteritis is closely correlated with the severity of the condition, with rotavirus being identified as the most severe infectious agent and often connected with the occurrence of dehydration. [23] The amount of sodium (Na^+) excretion in feces is contingent upon the specific bacteria responsible for the infection. In cases of cholera, the concentration of sodium ions (Na^+) in stool samples may reach levels as high as 90 mmol/L. Similarly, in instances of rotavirus-induced diarrhea, the concentration of sodium ions in stool samples typically ranges between 40 and 60 mmol/L. [24] The assessment of dehydration in children with severe diarrhea is often determined using established scoring systems, which serve as indicators of the severity of dehydration. [23] There was a significant association between hyponatremia and an extended duration of diarrhea ($P = 0.044$) in the patient population. Therefore, a prolonged duration of diarrhea before admission increases the probability of potential electrolyte imbalance, namely hyponatremia. This observation implies that timely identification and repair of this electrolyte imbalance might potentially decrease the length of diarrhea and therefore lower the risk of fatality, as supported by previous research findings. [25,26]

The evaluation of sodium values was conducted considering varying levels of dehydration, and it was shown that hyponatremia was the most prevalent sodium anomaly across all three groups categorized as mild, moderate, and severe dehydration. Within the cohort of slightly dehydrated individuals, a total of 40 patients were seen. Among these patients, 22 individuals (55%) exhibited hyponatremia, while the other 18 patients (45%) had normal salt levels. Similar patterns were seen in both moderately dehydrated and highly dehydrated individuals. Among a cohort of 50 patients who were moderately dehydrated, it was observed that 30 patients (60%) exhibited hyponatremia, whereas 18 patients (36%) had normonatremia, and just 2 patients (4%) presented with hypernatremia. Within the cohort of highly dehydrated individuals (n=114), it was seen that 52 patients (45.62%) exhibited hyponatremia, whereas normonatremia was detected in 44 patients (38.60%), and hypernatremia was identified in 14 patients (12.28%). The evaluation of potassium levels was conducted with respect to the extent of dehydration, and it was observed that normokalaemia was the prevailing outcome across all groups. Among the cohort of slightly dehydrated individuals (n=30), the majority of patients, namely 25 individuals (83.34%), exhibited normokalaemia, whereas a smaller subset of 5 patients (16.66%) had hypokalaemia. Out of the cohort of 40 patients who were moderately dehydrated, it was observed that 32 patients exhibited normokalaemia, whereas 6 patients (15%) had hypokalemia, and 2 patients (5%) developed hyperkalemia. Among the cohort of extremely dehydrated individuals (n=132), the majority of patients (n=119) exhibited normokalaemia, while a smaller proportion of patients (n=9) presented with hypokalemia. Hyperkalemia was seen in a minority of patients (n=2). There is a strong correlation between

diarrhea, malnutrition, and intestinal integrity, since children who are malnourished are more vulnerable to infections, especially those affecting the gastrointestinal system. Therefore, it can be seen that anorexia, decreased absorptive capacity, mucosal injury, and depletion of nutrients are all consequences that accompany each instance of diarrhea. A notable fraction of the case fatality seen in the present research were children who had concurrent malnutrition in different ways alongside their first episode of diarrhea. The majority of individuals had concurrent electrolyte imbalances that further exacerbated their diarrheal condition. [27,28]

Conclusion

A significant prevalence of electrolyte disturbances was seen in pediatric patients with acute gastroenteritis. It is important to promptly identify and treat children who exhibit symptoms of acute gastroenteritis together with electrolyte imbalances in order to mitigate the adverse health outcomes and fatalities associated with these conditions.

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