

CHALLENGES AND COMPLICATIONS ASSOCIATED WITH SODIUM, POTASSIUM IMBALANCES AND PREVENTIVE MEASURES IN CHILDREN UNDER-FIVE WITH ACUTE GASTROENTERITIS

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ABSTRACT

Objective: To determine the frequency of sodium and potassium abnormalities associated with acute gastroenteritis in children and its complications.

Study Design: Cross sectional study.

Place and Duration of Study: Pediatric Medicine Department of Shaikh Zayed Hospital, Lahore, from Jan to Dec 2019.

Methodology: Two hundred and eighteen children were recruited in the study according to inclusion and exclusion criteria. After taking informed consent, their demographic data recorded, blood samples were taken and examined for serum sodium and potassium levels. The complications arising from sodium and potassium abnormalities were also noted.

Results: There were 101 (46.3%) males while 117 (53.7%) females with male to female ratio of 1:1.2. Mean age was 1.87 ± 1.30 years. 42 (19.2%) children had sodium abnormality, 93 (42.7%) children had potassium abnormalities and 83 (38.1%) children had no abnormality. Out of 29 (13.3%) children had complications while 189 (86.7%) children were without complications.

Conclusion: We concluded that 42 (19.2%) children had sodium abnormality, 93 (42.7%) children had potassium abnormalities and 13.3% patients developed complication. This can be prevented by implementing hygienic practices, routine vaccinations and prompt rehydration.

Keywords: Acute gastroenteritis, Dehydration, Sodium abnormality, Potassium abnormality, Complications.

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INTRODUCTION

Diarrhea is the second major cause of mortality in under-five. It kills 525,000 under-five children every year. Globally, there are 1.7 billion cases of childhood diarrheal diseases annually. Morbidity and mortality due to acute gastroenteritis is mainly due to electrolyte abnormalities and their complications.¹ According to WHO, one in every 6 seconds, a child dies due to complication of diarrhea, around the world.^{2,3} Despite adequate use of oral rehydration, electrolyte abnormalities are still observed in many children with acute gastroenteritis.^{4,5} A high index of suspicion, timely identification and thorough understanding of electrolyte variations is required to ensure complete amendment.⁶

Diarrhea is defined as passage of three or more liquid stools per day or increased frequency of stools. It can be caused by various pathogens with variable prevalence in different regions of the world. *Rotavirus*, *E.coli*, *Salmonella*, *Shigella*, *Campylobacter Jejuni* are a few on the top of the list.^{7,8} Acute gastroenteritis frequently causes sodium and potassium abnormalities. Sodium level $<135\text{meq/L}$ and $>150\text{meq/L}$ while potassium

level $<3.5\text{meq/L}$ and $>5\text{meq/L}$ is considered abnormal. Hyponatremia causes brain hemorrhages, seizure, hypercoagulability-thrombotic changes while hyponatremia causes coma, seizures, muscle cramps and weakness.⁹ Hyperkalemia causes arrhythmias, palpitations while hypokalemia causes paralysis, hypotonia, muscle weakness and cramping.¹⁰

A study conducted in Nigeria showed that sodium abnormality was present in 60.3% of cases while potassium abnormality in 14.3% of children with acute gastroenteritis.¹¹ A large regional study conducted in India reported 2nd and 3rd frequent electrolyte abnormality as hyperkalemia (26.40%) and hyponatremia (20.60%) in under-five children with acute gastroenteritis.¹² A local study conducted in Pak Emirates Military Hospital Rawalpindi reveals hyponatremia in 32.5%, hypokalemia in 55% and no electrolyte abnormality in 12.5% of children.¹³ There is paucity of recent local evidence about the electrolyte abnormalities in children with acute gastroenteritis. Moreover, literature has showed varied data regarding electrolyte abnormalities in children with acute gastroenteritis. Rationale of the study is to determine the frequency of sodium and potassium abnormalities and its complications in children with acute gastroenteritis in our

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population, for improvement of our knowledge and hence establishing authentic guidelines for the best management of patients in our healthcare setup.

METHODOLOGY

A study with cross-sectional design was conducted at Pediatric Medicine Department of Shaikh Zayed Hospital, Lahore Pakistan, from January to December 2019. Ethical approval (Ref no. F.39/NHRC/Admn/IRB/90) was taken from Internal Review Board of Shaikh Zayed Hospital, Lahore.

Sample size of 218 patients was calculated with 95% confidence level and 5.0% margin of error using Raosoft software. Patients were recruited through non-probability consecutive sampling technique. Informed consent was taken from the parents/guardians of the patients.

Inclusion Criteria: We included all children under 5 years of age, both genders, presenting with acute gastroenteritis according to the operational definition. We made sure that their blood sample for serum electrolytes is taken within 14 days of onset of symptoms.

Exclusion Criteria: We excluded all the children having liver disease (ALT>40IU/L, AST>40IU/L), renal disease (serum creatinine >1.2mg/dL) and diabetes mellitus. All children with bloody diarrhea, chronic diarrhea, not willing to consent, malnutrition or immunocompromised state were excluded from the study. Children with inborn error of metabolism or congenital adrenal hyperplasia/adrenal insufficiency were also the part of exclusion criteria.

After taking informed consent from the selected patients, we recorded their demographic data like age, gender, weight, and duration of symptoms. Then 2cc blood sample was taken in a vial (Gel and Clot activator) and all samples sent to the laboratory of the hospital. The reports were analyzed and abnormal sodium & potassium levels were recorded in a predesigned proforma.

Data was analyzed using SPSS version 23. Quantitative variables like age, weight and duration of acute gastroenteritis were interpreted as mean and standard deviation. Qualitative variables such as gender and electrolyte abnormalities were recorded as frequency and percentages. Acute gastroenteritis results were stratified for age, race, weight, and length. Amid stratification, a sodium, potassium abnormality study was conducted in stratified groups for comparison. Post-stratification Chi-square test was applied by taking p -value of ≤ 0.05 as statistically significant.

RESULTS

Out of total 218 patients, 155 (71.1%) children belonged to age 0.1-2 years and 63 (28.9%) children belonged to age 2.1-5 years with mean age 1.87 ± 1.30 years. There were 101 (46.3%) males while 117 (53.7%) females with male to female ratio of 1:1.2. According to weight, 105 (48.1%) children had weight between 3-10 kgs while 113 (51.9%) were between 11-18 kgs with mean weight as 11.07 ± 3.25 kgs. According to duration of gastroenteritis, 118 (54.1%) had duration between 1-7 days and 100 (45.9%) had 8-14 days with mean duration as 7.32 ± 2.88 days (Table-I).

Table-I: Electrolyte abnormalities and complications.

Electrolyte Abnormality	Frequency	Percentage
Sodium abnormality	42	19.2%
Hyponatremia	27	64.3%
Hypernatremia	15	35.7%
Potassium abnormality	93	42.7%
Hypokalemia	71	76.3%
Hyperkalemia	22	23.7%
Complications	29	13.3%
Paralytic ileus	18	62.1%
Hypotonia	5	17.2%
Seizures	3	10.4%
Arrhythmia	2	6.8%
Brain hemorrhage	1	3.5%

$n=218$

Based upon the finding in the Table-II, majority of the study participants 93 (42.7%) had undergone Potassium abnormality. Analysis of complications associated with sodium-potassium abnormality has revealed maximum cases of paralytic ileus 18 (62.1%) and least frequency of Brain hemorrhage 1 (3.5%) (Table-II).

Table-II: Stratification of electrolyte abnormality according to age, weight, gender, and duration of acute gastroenteritis.

	Sodium Abnormality		p -value	Potassium Abnormality		p -value
	Yes	No		Yes	No	
Age (years)						
0.1-2	43	132	0.059	87	88	0.045
2.1-5	15	27		25	18	
Gender						
Male	19	82	0.01	56	45	0.264
Female	40	77		56	61	
Weight (kgs)						
3-10	21	59	0.83	36	44	0.034
11-18	38	100		76	62	
Duration of Acute Gastroenteritis (days)						
2-7	29	89	0.36	63	55	0.518
8-13	30	70		49	51	

Stratification of data evaluated significant p -value for sodium abnormality according to age and gender while significant p -value for potassium abnormality was observed in age and weight of children, while non-significant relationship exists between sodium &

potassium abnormality and duration of acute gastroenteritis.

DISCUSSION

Diarrhea is the second major leading cause of death in children under five years of age. In the United States, gastroenteritis represents about 10% of admissions to medical clinic, >1.5 million outpatient visits, and around 300 deaths in under-five children annually with an expense of around \$1bn. Our study showed that out of 218 patients, 101 (46.3%) were males while 117 (53.7%) were females with male to female ratio of 1:1.2 and mean age of patient was 1.87 ± 1.30 years. We discovered that 42 (19.2%) children had sodium abnormality while 176 (80.8%) children had no sodium abnormality. Among sodium abnormal children, 15 (35.7%) children had hypernatremia and 27 (64.3%) children had hyponatremia. Potassium abnormality was found in 93 (42.7%) children while 125 (57.3%) children had no potassium abnormality. Among potassium abnormal children, 71 (76.3%) had hypokalemia while 22 (23.7%) had hyperkalemia. Our study also revealed that 29 (13.3%) children had complications, paralytic ileus in 18 (62.1%), hypotonia in 5 (17.2%), seizures in 3 (10.4%), arrhythmia in 2 (6.8%) and brain hemorrhage in 1 (3.5%) child. When data was stratified, there was significant *p*-value for sodium abnormality according to age and gender while significant *p*-value for potassium abnormality was observed in age and weight of children.

A study similar to ours conducted by Okposio *et al* took total 185 patients, out of which 57.8% were males and 42.2% were females, hyponatremic dehydration was found in 60.5% of cases.¹⁴ A study conducted at Military Hospital Rawalpindi shows comparable results of hyponatremia in 26 (32.5%) patients, hypokalemia in 44 (55%) and no electrolyte abnormality in 10 (12.5%) children.¹³ Odey *et al* studied potassium abnormality in children with diarrhea and reported hypokalemia in 45 (23.4%) children.¹⁵

Most of the studies confirm that hyponatremia is the commonest electrolyte abnormality in acute gastroenteritis, but it is not consistent with our study. A study conducted by Pratima *et al* reported the frequency of hyponatremic dehydration in 49 (62.5%), isonatremic dehydration in 31 (38.7%) and hypokalemia in 21 (26.5%) children.¹⁶ Sharma *et al* discovered hyponatremia in 52.3% children with gastroenteritis.¹⁷ A local study in Nishter Medical University, Multan revealed hyponatremia in 118 (62.8%) and hypokalemia in 77 (41%) children with diarrhea.¹⁸ Another study done

in Pakistan gives surprising results. Hyperchloremia (53.8%) was the commonest abnormality, followed by hyperkalemia (26.9%) and hypernatremia (17.3%).⁶ Most of the studies have not discussed complications of electrolyte abnormality.

As acute gastroenteritis is the second major leading cause of death in children under-five, it should be taken seriously. Preventive measures include hygienic practices, food and water sanitation and routine immunization specially rota virus vaccination. Moreover, any child sick with acute gastroenteritis should be immediately taken to nearest medical facility and prompt rehydration should be initiated without delay. Integrated Management of Childhood Illnesses (IMNCI) is a program initiated by Government to spread awareness for a common man to promptly recognize and initiate emergency treatment of major childhood illnesses.

Our study is limited to the children presenting to Shaikh Zayed Hospital only with a sample size of two hundred and eighteen patients. We have not studied the risk factors associated with acute gastroenteritis and its complications. Need of the hour is to conduct large scale studies in all major tertiary care hospitals to get thorough knowledge about the electrolyte abnormalities in acute gastroenteritis and hence timely management of these abnormalities. This will lower the overall hospital stay, financial burden and under-five mortality rate.

CONCLUSION

Sodium and potassium abnormalities are frequently found in children with acute gastroenteritis and highly associated with morbidity and mortality among children with dehydration. We concluded from this study that 42 (19.2%) children had sodium abnormality, 93 (42.7%) children had potassium abnormality and 29 (13.3%) patients developed complications in which paralytic ileus was the commonest complication followed by hypotonia, seizures, arrhythmia and brain hemorrhage. All these complications can be prevented by implementing hygienic practices, eliminating the malnutrition from our society and ensuring the timely use of oral rehydration solution during acute gastroenteritis.

Conflict of Interest: None.

Author's Contribution

LR: Supervision, MKH: Conceptualization, MJ: Manuscript writing, AT: Data analysis, SI: Methodology, NF: Data collection.

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