

ORIGINAL ARTICLE

Study of electrolyte disturbances and renal parameters in acute gastroenteritis under 5 years of age in a tertiary care hospital of Chhattisgarh, India

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ABSTRACT:

Introduction: In the present study, an attempt has been made to outline the spectrum of electrolyte disturbances and renal involvement in children with acute gastroenteritis. **Materials and Methods:** Study Participants were divided into two groups based on their age. In Group-1: Children in the age range of 3 months to 12 months were included and in the Group-2: Children in the age range of 13 months to 24 months were considered to correlate different degrees of the dehydration and types of dyselectrolytemia. All children aged one month to 5 years with acute gastroenteritis admitted in the Paediatric department were included. **Results:** Majority of admitted children with AGE had isonatremia (55.9%) followed by hyponatremia in 34.6% cases. Hypernatremia was seen in only 7% of the study population. Isokalemia was seen in majority (78.7%) followed by hypokalemia in 13.3% cases. Hyperkalemia was seen in 7.8% of the children. **Conclusion:** Dyselectrolytemia particularly hyponatremia and hypokalemia are seen in children with acute diarrhea. The level of serum sodium and potassium decreased and urea and creatinine increased with severity of dehydration. Improper dilution of ORS can lead to electrolyte imbalance.

Keywords: Dyselectrolytemia, hyponatremia, hypokalemia, diarrhea, serum sodium, potassium decreased, urea and creatinine

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INTRODUCTION

Diarrhea as defined by WHO is the “passage of loose or watery stools at least three times in a 24 hour period” but emphasizes the importance of change in stool consistency rather than frequency, and the usefulness of parental insight in deciding whether children have diarrhea or not.^{1,2} The global annual measure of diarrhoea and dehydration is huge, affecting 3.5 billion cases and causing approximately 2 million deaths per year. Diarrhoea accounts for over 20% of all deaths in under 5 years of age children. Significant dehydration with abnormal electrolytes and acid base status occurs in 2.5% of all cases of diarrhoea which may be fatal.³ The term Gastroenteritis denotes infections of the gastrointestinal (GI) tract caused by bacterial, viral, or parasitic pathogens.⁴ Worldwide, Gastrointestinal diseases are considered as common illnesses, the second most common cause for visits to physicians, and of morbidity and mortality among infants and children under five throughout the developing world. The global annual measure of diarrhoea and dehydration is huge, affecting 3.5 billion cases and causing approximately 2 million deaths per year. Diarrhoea accounts for over 20% of all deaths in under 5 years of age children. Significant dehydration with abnormal electrolytes and acid base status occurs in 2.5% of all cases of diarrhoea which may be fatal.³

Electrolyte disturbances are well known in dehydration. Disturbance in sodium, potassium, chloride and bicarbonate have been studied by many workers.

The clinical manifestations of acute diarrhoea are related to the severity of water deficit and the type of electrolyte disturbances. Often laboratory facilities are not available or, even if available; there is a considerable time lag in obtaining the results. Consequently, clinical recognition of water and electrolyte disturbances becomes important, particularly Hyponatremic dehydration, due to its serious neurological consequences. A study conducted in 2010 in Dhaka Shishu hospital showed that electrolyte disturbances in Acute Gastroenteritis was associated with increased morbidity, with hyponatremic dehydration in 15% cases.⁵

Isonatremic dehydration is the commonest (70-80%) type of dehydration and the type with the best prognosis. Other biochemical disturbances observed include hypokalaemia and metabolic acidosis and impaired renal function. However, in clinical settings, the degree of dehydration is often classified as no dehydration, some dehydration and severe dehydration based on the estimated fluid loss and other clinical parameters.⁶ Dehydration is the most frequent and dangerous complication responsible for morbidity and mortality in children with acute

diarrhoeal disease.⁷ Serum electrolyte and acid base disturbances are common in under-five children with acute diarrhea but may remain unrecognized, resulting in morbidity and sometimes mortality. Timely recognition, a high index of suspicion and a thorough understanding of common electrolyte abnormalities is necessary to ensure their correction.

During the past three decades, factors such as the widespread availability and use of Oral Rehydration Solution (ORS), improved rates of breastfeeding, improved nutrition, better sanitation and hygiene, and increased coverage of measles immunization are believed to have contributed to a decline in the mortality rate in developing countries. However, the morbidity from diarrheal diseases has remained relatively constant during the past two decades. Different studies have shown different incidences of electrolyte disorders among children with dehydration. In the present study, an attempt has been made to outline the spectrum of electrolyte disturbances and renal involvement in children with acute gastroenteritis. The effect of consumption of improperly diluted ORS on electrolytes status has also been studied.

METHODS

In the present study, by only those patients were included who fulfilling the inclusion criteria of study and admitted in the department of Pediatrics at Chandulal Chandrakar Memorial Medical College, Kachandur, Durg, India. This study was conducted from November 2013 to August 2014. Study Participants were divided into two groups based on their age. In Group-1: Children in the age range of 3 months to 12 months were included and in the Group-2: Children in the age range of 13 months to 24 months were considered to correlate different degrees of the dehydration and types of dyselectrolytemia.

INCLUSION CRITERIA

All children aged one month to 5 years with acute gastroenteritis admitted in the Paediatric department were included.

EXCLUSION CRITERIA

RESULTS

Total 127 children were enrolled in the study as per the inclusion criteria which represented 5% of the total paediatric admissions. Table 1 shows that majority (62.2%) had some dehydration, 19.6% had no dehydration and 18.1% had severe dehydration.

Table 1: Degree of dehydration based on WHO criteria

Degree of dehydration	Frequency	Percentage
No dehydration	25	19.6
Some dehydration	79	62.2
Severe dehydration	23	18.1

Majority of admitted children with AGE had isonatremia (55.9%) followed by hyponatremia in 34.6% cases. Hypernatremia was seen in only 7% of the study population.

Any child with history of diarrhea more than two weeks (Persistent diarrhoea) at the time of admission; parental diarrhea; children with dysentery (blood and mucus in stool); children with known pre-existing renal disease, children who underwent renal replacement therapy before admission were excluded.

Demographic profile of the patients, detailed history, details of diarrhea such as duration, frequency, consistency of stools, examination and investigations were recorded. ORS intake before coming to the hospital was also made. Preparation of the ORS was asked in detail. A detailed examination was done to assess the degree of dehydration as per the WHO criteria and any associated complication, presence or absence of features suggestive of dyselectrolytemia and renal involvement.

DEFINITIONS

SERUM SODIUM LEVELS

- Normal Sodium levels- 135-145 mmol/l;
- Hyponatremia <135 mmol/l;
- Hypernatremia >145 mmol/l.

SERUM POTASSIUM LEVELS

- Normal Potassium levels- 3.5-5.5 mmol/l;
- Hypokalemia <3.5 mmol/l;
- Hyerkalemia >5.5 mmol/l.

Fluid therapy: This was designed to correct dehydration, electrolyte imbalance, acidosis and maintain urinary output.

Using this software, basic cross-tabulation and frequency distributions were prepared. Chi-square test was used to test the association between different study variables. Corrected Chi-square test was used in case any one of cell frequency was found less than 5 in the bivariate frequency distribution. Fisher's Exact Test was used where Chi-square test could not be applied.

Test of proportion (Z-test) was used to test the significant difference between two proportions. t-test was used to test the significant difference between means. $p \leq 0.05$ was considered statistically significant.

Isokalemia was seen in majority (78.7%) followed by hypokalemia in 13.3% cases. Hyperkalemia was seen in 7.8% of the children (Table 2).

Table 2: Frequency of patients with different status of electrolytes and renal parameters

Biochemical Parameters	Levels	Frequency	Percentage
Serum sodium	Normal	71	55.9
	Low	44	34.6
	High	12	9.4
Serum potassium	Normal	100	78.7
	Low	17	13.3
	High	10	7.8
Serum urea	Normal	95	74.8
	High	32	25.1
Serum creatinine	Normal	114	89.7
	High	13	10.2

Table 3 depicts the frequency of different biochemical parameters in children with AGE. The mean levels of serum sodium, potassium, urea, creatinine in different age groups of our study population were not significant statistically.

Table 3: Mean (SD) levels of biochemical parameters in different age groups in months

Parameter	1-12m	13-24m	25-36m	37-48m	49-60m	F Value	P value
Na ⁺	138.70 ± 7.72	136.81 ± 5.82	134.21 ± 5.81	135.5 ± 8.41	135.3 ± 7.60	1.9	0.13
K ⁺	5.31 ± 0.73	5.25 ± 0.66	5.3 ± 0.74	4.83 ± 0.64	4.91 ± 0.84	1.5	0.23
Urea	35.40 ± 1.61	31.28 ± 14.61	27.2 ± 18.2	38.3 ± 20.41	27.30 ± 9.61	1.1	0.34
Creatinine	0.43 ± 0.19	0.5 ± 0.26	0.43 ± 0.154	0.52 ± 0.193	0.43 ± 0.134	0.68	0.63

*p value <0.05 is significant

Table 4 shows that levels of serum sodium and potassium decreased with the severity of dehydration (no dehydration- 138.40 ± 4.31; 5.21 ± 0.55, some dehydration 137.94 ± 5.41; 5.21 ± 0.62, severe dehydration 133.21 ± 12.71; 5.20 ± 2.16). Majority had normal urea (84%) and creatinine (95%) levels. Urea and creatinine levels were raised in 24% and 8% of the children respectively.

Table 4: Comparison of serum electrolytes mean (SD) with hydration status of children

Serum Electrolytes (mEq/L)	Group 1	Group 2	Group 3
Sodium	138.40 ± 4.31	137.94 ± 5.41	133.21 ± 12.71
Potassium	5.21 ± 0.55	5.21 ± 0.62	5.20 ± 2.16

Group 1 - no dehydration; group 2 - some dehydration; group 3 - severe dehydration

Table 5 shows serum urea and creatinine were significantly high in severe dehydration [46.11 ± 21.15; 0.8 ± 0.280] as compared to some dehydration [31.22 ± 15.02; 0.40 ± 0.155] and no dehydration [23.91 ± 9.19; 0.34 ± 0.050] p value 0.001*

Table 5: Comparison of renal parameters mean (SD) with hydration status of children.

Renal Parameters (mg/dl)	Group 1	Group 2	Group 3	F value	P value
Urea	23.91 ± 9.19	31.22 ± 15.02	46.11 ± 21.15	12.5	0.001*
Creatinine	0.34 ± 0.050	0.40 ± 0.155	0.6 ± 0.281	14.8	0.001*

*p value <0.05 is significant.

Out of the 38 patients who were given ORS before admission, most of them (50%) were given diluted ORS (Table 6).

Table 6: Type of ORS given before admission

Type of ORS before admission	Frequency	Percentage
Appropriate	12	31.5
Diluted	19	50
Concentrated	7	18.4
Total	38	100

DISCUSSION

The incidence of AGE is varied in different areas of India among hospitalised cases. Ramanaiah et al, Srivastava et al, Behera et al and Ahmed et al reported an incidence of 12.1%, 12.3%, 11.3% and 14.2% respectively. Poo et al.[15] reported that acute gastroenteritis was responsible for 6% of the total paediatric admission, which was comparable to this study.⁸⁻¹¹ In the present study, the incidence was 5%. Poo et al reported that acute gastroenteritis was responsible for 6% of the total paediatric admission which was similar to our study.¹² In another study done by Yilgwan et al in Nigeria, the incidence of acute gastroenteritis was only 2.7%.¹³

The present study shows that children aged 1-12 months had the highest incidence of diarrhea (50%), which was followed by 13-24 months (23%), 49-60 months (13%), and 25-36 months (10%). A study by Krishnan S et al also reported isonatremia in majority of the cases (59%), followed by hyponatremia (25%) and then hypernatremia (15%).^{14,9,10}

study done by Stanly et al.¹⁵ reported that the average number of times of diarrhea per child per day was 5 with a minimum number of 3 and maximum of 10. Kolahi et al.¹⁶ reported the mean frequency of diarrhea was 5.1±5 episode per day. Srivastava et al conducted a study, 110 hospitalized children up to 3 years of age suffering from diarrhoea were investigated. The peak of admission due to diarrhoea was in the month of June. Cases aged 0-12 months constituted 72.8% of the total number of cases.¹⁷ Shah GS et al study showed Majority (70%) of patients were below 2 years of age.¹⁸

Similar result was seen in the study conducted by Ukarapol et al where 24% of the patient had increased BUN and the BUN correlated statistically with the degrees of dehydration.¹⁹ In our study, out of 117 acute gastroenteritis cases, 90 (77%) had normal urea, whereas 27 (23%) had increased serum urea level. This study also shows that 8 (7%) cases had increased serum creatinine, while 109 (93%) had normal serum creatinine level. Furthermore, out of the cases with increased serum urea, majority was seen in some dehydration 15 (55%) followed by 11 cases of severe dehydration (41%) and only 1 (4%) case of no dehydration. Out of the cases with increased serum creatinine levels, majority was seen in some dehydration (n=5, 62.5%), followed by 3 cases of severe dehydration (37.5%).

None of the cases with no dehydration had raised creatinine levels. Serum urea and creatinine were significantly high in severe dehydration as compared to some dehydration and no dehydration (p value 0.001*).

Most of the children (n=89, 76%) were not given ORS before admission. Out of the 28 patients who were given ORS before admission, most of them (n=16, 57%) were given diluted ORS before admission. 3(11%) children were given concentrated ORS and 9(32%) were given appropriate ORS before admission. Dehydration is major cause of morbidity and mortality in infants and young children worldwide. The present study shows that some dehydration was observed in most number of cases (n=76, 65%), followed by no dehydration (n=22, 19%) and severe dehydration (n=19, 16%). Mittal et al had reported 50.52% of some dehydration and 21.95% severe dehydration in their study.²⁰ Tavakolizadeh et al in their study reported that among children admitted with acute gastroenteritis, 64.9% had no dehydration, 32.7% had some dehydration and 2.4% cases had severe dehydration.²¹

CONCLUSION

Dyselectrolytemia particularly hyponatremia and hypokalemia are seen in children with acute diarrhea. The level of serum sodium and potassium decreased and urea and creatinine increased with severity of dehydration. Improper dilution of ORS can lead to electrolyte imbalance.

Timely recognition and correction of electrolyte disturbances, promotion of health awareness, breastfeeding, weaning with hygienically prepared foods, and demonstration of how to prepare appropriate ORS solution, better female literacy and health education will go a long way in reducing the morbidity and mortality associated with AGE. Like any other electrolyte abnormalities which occur in conditions other than diarrhoea, are basically asymptomatic & does not require aggressive correction of electrolytes. They do very well with ORS & fluid correction as recommended by W.H.O.

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