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STUDY OF ELECTROLYTE PROFILE OF CHILDREN BETWEEN AGE 6 TO 60 MONTHS WITH DEHYDRATION DUE TO DIARRHEA ADMITTED IN A TERTIARY CARE HOSPITAL

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ABSTRACT Acute diarrheal diseases are one of the leading causes of death in children in the developing countries. Death in diarrhea mostly occurs due to dehydration and electrolyte imbalance. Irrespective of the cause of diarrhea, early initiation of oral rehydration therapy in the form of oral rehydration salts (ORS) is a simple, easy, economic and effective way to prevent complications and death due to diarrhea. Glucose present ORS causes glucose-linked sodium absorption accompanied by the absorption of water and other electrolytes.

KEYWORDS : Diarrhea, hyponatremia, oral rehydration salts

INTRODUCTION

Acute diarrheal diseases are among the leading causes of mortality in children of developing countries. Worldwide, each year an estimated 1.7 billion cases of acute diarrhea and nearly 7 million deaths occurs in under-5 children.[1]

During diarrhea there is an increased loss of water and electrolytes like Sodium (Na), Chloride (Cl), Potassium(K) and Bicarbonate(HCO_3) through stool. Water and electrolytes are also lost through vomit, sweat, urine and breathing. Dehydration occurs when these losses are not replaced adequately and a deficit of water and electrolytes develops. The volume of fluid lost through the stools in 24 hours can vary from 5 ml/kg (near normal) to 200 ml/kg, or more. [2] In severe dehydration, patient may develop hypovolemic shock characterized by reduce or absent urine output, cool moist extremities, a rapid and feeble pulse, low or undetectable blood pressure and even altered sensorium, heart failure or convulsion. Death follows soon if rehydration is not started quickly.[3]

Severe infectious diarrhea is caused by Rotavirus, Enterotoxigenic Escherichia coli (ETEC), Vibrio cholerae O1 or O139.[4] Under circumstances of poor environmental sanitation and hygiene, inadequate water supply and poverty. Diarrhea related deaths may result from immediate or long term consequences of the disease.[5] The immediate effect includes fluid and electrolyte derangements with an upset in the body's acid base regulation since extracellular fluid osmolarity and volume are determined by Na and K contents.

In most cases, death is caused by dehydration and electrolyte imbalance. These can be prevented by replenishing the loss with a simple, effective, cheap oral fluid at home which is adequate in glucose-electrolytes and appropriate for all age groups, called Oral Rehydration Salts (ORS) solution.[6] Hence, the current study was conducted to see the efficacy of ORS in preventing mortality and morbidity from diarrhea.

MATERIALS AND METHODS

A prospective observational study was carried out on 148 children aged 6-60 months who were admitted in Pediatrics ward of R.G. Kar medical college and Hospital with some or severe dehydration due to diarrhea. Patients with obvious illness like malabsorption, severe pneumonia, meningitis, dysentery were excluded. A detailed clinical history was taken enquiring duration of diarrhoea, frequency of stools in last 24 hours, whether breast feeding or not, consistency of stool, history of vomiting and number of vomiting episodes in the last 24 hrs, history of fever, history of antibiotic use, duration of treatment, ORS use before admission, measles immunization, history of measles in last 3 months. Thorough clinical examination was carried out to as per IMNCI guidelines to classify the case as no dehydration, some dehydration or severe dehydration. Venous blood sample was drawn on Day 0, 1, 2 of illness for estimation of Na, K, HCO_3 levels. All patients were treated according to status following Plan A, B or C for dehydration.

Data had been summarized as mean and standard deviation for numerical variables and count and percentages for categorical variables. P value was calculated using One-way analysis of variance (one-way ANOVA) and chi-squared test ($\chi2$ test). P-value $\leq$ 0.05 was considered as statistically significant. All Statistical analysis was done by using SPSS 24.0. and Graph Pad Prism version 5.

RESULTS

The study showed that in patients with history of prior ORS intake, serum Na and HCO_3 levels on admission, Day 2 and Day 3 were more compared to those who haven't taken ORS before admission. The difference in HCO_3 levels on admission, Day 2 and Day 3 was statistically significant while for Na it was statistically significant on admission and Day 2. Likewise, statistically significant difference was found in levels of mean serum Na and HCO_3 in some and severe dehydration on admission, Day 2 and Day 3. Statistically significant difference was also found in levels of mean serum K on admission between those with versus without prior ORS intake as well as in some versus severe dehydration. **(Table 1 and 2)**

Table: 1. Distribution of mean Na, K, HCO3 on admission, Day 2 and Day 3

	Degree of dehydration	Number	Mean	SD	Minimum	Maximum	Median	p-value
Na on Admission	Severe	35	129.9429	5.5516	117.0000	139.0000	131.0000	<0.0001
	Some	113	133.8053	3.9548	123.0000	147.0000	134.0000	
Na on Day 2	Severe	35	135.5429	3.5591	127.0000	144.0000	136.0000	0.0007
	Some	113	137.6460	2.9848	131.0000	146.0000	137.0000	
Na on Day 3	Severe	35	137.9429	2.2873	134.0000	144.0000	138.0000	0.0277
	Some	113	138.8496	2.0495	135.0000	145.0000	139.0000	

K on Admission	Severe	35	3.4057	.3985	2.7000	4.1000	3.4000	0.0005
	Some	113	3.6336	.3090	3.0000	4.5000	3.6000	
K on Day 2	Severe	35	3.7400	.3229	3.2000	4.4000	3.8000	0.3630
	Some	113	3.7850	.2300	3.2000	4.5000	3.7000	
K on Day 3	Severe	35	3.8343	.2057	3.4000	4.2000	3.8000	0.8467
	Some	113	3.8416	.1917	3.5000	4.3000	3.8000	
HCO3 on Admission	Severe	35	21.0086	1.5747	18.0000	24.1000	20.9000	<0.0001
	Some	113	22.2177	1.4012	18.5000	24.8000	22.5000	
HCO3 on Day 2	Severe	35	22.5657	.7561	20.6000	23.6000	22.7000	0.0003
	Some	113	23.1018	.7555	21.2000	24.6000	23.1000	
HCO3 on Day 3	Severe	35	23.0571	.3550	22.5000	23.8000	23.0000	0.0012
	Some	113	23.3673	.5195	22.1000	24.7000	23.4000	

Table: 2. Distribution of mean Na, K, HCO3 on admission, Day 2 and Day 3 with degree of dehydration

	Prior ORS INTAKE	Number	Mean	SD	Minimum	Maximum	Median	p-value
Na on Admission	No	76	131.7105	4.3292	117.0000	138.0000	132.0000	0.0013
	Yes	72	134.1389	4.7093	118.0000	147.0000	135.0000	
Na on Day 2	No	76	136.1974	2.6129	128.0000	142.0000	136.0000	0.0002
	Yes	72	138.1528	3.5471	127.0000	146.0000	138.0000	
Na on Day 3	No	76	138.3158	2.1677	134.0000	144.0000	138.0000	0.0614
	Yes	72	138.9722	2.0622	134.0000	145.0000	139.0000	
K on Admission	No	76	3.5000	.3717	2.8000	4.5000	3.5000	0.0035
	Yes	72	3.6639	.2937	2.7000	4.2000	3.7000	
K on Day 2	No	76	3.7513	.2610	3.2000	4.5000	3.7000	0.2599
	Yes	72	3.7986	.2469	3.2000	4.4000	3.8000	
K on Day 3	No	76	3.8342	.2114	3.4000	4.3000	3.8000	0.7175
	Yes	72	3.8458	.1760	3.5000	4.3000	3.8000	
HCO3 on Admission	No	76	21.4303	1.6324	18.0000	24.8000	21.6500	<0.0001
	Yes	72	22.4611	1.2110	18.6000	24.5000	22.5500	
HCO3 on Day 2	No	76	22.7447	.8322	20.6000	24.6000	22.6500	0.0002
	Yes	72	23.2181	.6587	21.2000	24.5000	23.2000	
HCO3 on Day 3	No	76	23.1763	.4566	22.1000	24.2000	23.1000	0.0031
	Yes	72	23.4181	.5212	22.6000	24.7000	23.4500	

DISCUSSION

Oral rehydration therapy is based on the principle that intestinal absorption of sodium (and thus of other electrolytes and water) is enhanced by the active absorption of certain food molecules such as glucose (which is derived from the breakdown of sucrose or cooked starches) or l-amino acids (which are derived from the breakdown of proteins and peptides). Fortunately, this process continues to function during secretary diarrhea, whereas most other pathways of intestinal absorption of sodium are impaired. Thus, if patients with secretary diarrhea drink an isotonic salt solution that contains no source of glucose or amino acids, sodium is not absorbed and the fluid remains in the gut, ultimately adding to the volume of stool passed by the patient. However, when an isotonic solution of glucose and salt is given, glucose-linked sodium absorption occurs and this is accompanied by the absorption of water and other electrolytes.[7] This process can correct existing deficits of water and electrolytes and replace further fecal losses in most patients with secretary diarrhea, irrespective of the cause of diarrhea or the age of the patient.

The principles underlying ORT have been applied to the development of a balanced mixture of glucose and electrolytes has been prepared for use in treating and preventing dehydration, potassium depletion and base deficit due to diarrhea. To attain the latter two objectives, salts of potassium and citrate (or bicarbonate) have been included, in addition to sodium chloride. This mixture of salts and glucose is termed oral rehydration salts (ORS); when ORS is dissolved in water, the mixture is called ORS solution. [8]

Dastidar RG et al [9] in a study on acute gastroenteritis (AGE) patients, found that 22% had hyponatremia, 71.5% had isonatremia and 6.5% had hypernatremia. Out of 30 children who were suffering from hyponatremic dehydration and had ORS before admission, 83.3% were given diluted ORS. Clinical features significantly associated with hyponatremia were increased frequency of diarrhea, absence of thirst, tachycardia, abdominal distension and severe dehydration. Hyponatremic dehydration is the second most common type of dehydration next to isonatremic dehydration, but it is more common in children who took diluted ORS. Hyponatremic dehydration may be suspected from the history and clinical features. Increased awareness regarding ORS preparation may help in preventing hyponatremia in AGE. Similar conclusion was drawn by Anigilaje EA et al. [10]

WHO found that oral rehydration therapy is adequate to correct mild to moderate isonatraemic dehydration, parenteral fluid therapy is safer for the child with severe dehydration and those with changes in serum sodium. Our study showed that in patients with history of prior ORS intake, serum Na levels on admission, Day 2 and Day 3 were more compared to those who haven't taken ORS before admission. The difference in Na on admission and Day 2 was statistically significant. Likewise, statistically significant difference was found in levels of mean serum Na in some and severe dehydration on admission, Day 2 and Day 3.

Shah BH et al[11] found that increased frequency of stool and vomiting were most common presenting symptoms while most common electrolyte imbalance in study was hyponatremia followed by hypokalaemia. Patients with diarrhea often develop potassium depletion owing to large faecal losses of this ion; these losses are greatest in infants and can be especially dangerous in malnourished children, who are frequently potassium-deficient before diarrhea starts. In ABG analysis severe metabolic acidosis was found in most of cases. When potassium and bicarbonate are lost together, hypokalaemia does not usually develop. This is because the metabolic acidosis that results from the loss of bicarbonate causes potassium to move from ICF to ECF in exchange for hydrogen ion, thus keeping the serum potassium level in a normal or even elevated range. However, when metabolic acidosis is corrected by giving bicarbonate, this shift is rapidly reversed, and serious hypokalaemia can develop. This can be prevented by replacing potassium and correcting the base deficit at the same time. ORS usage promotion in mild and moderate cases of dehydration is the best way for preventing severe dehydration and dyselectrolytemia.

Our study showed that in patients with history of prior ORS intake, serum HCO_3 levels on admission, Day 2 and Day 3 were more compared to those who haven't taken ORS before admission. The difference in HCO_3 levels on admission, Day 2 and Day 3 was statistically significant. Statistically significant difference was seen in levels of serum HCO_3 in some and severe dehydration on admission, Day 2 and Day 3. Statistically significant difference was also found in levels of mean serum K on admission between those with versus without prior ORS intake as well as in some versus severe dehydration.

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