Analysis of Electrolyte Abnormalities in Children with Diarrhoea in Relation to Their Type of Feeding: An Observational Study

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Abstract

Aim: This study was mainly aimed at analysing electrolyte abnormalities in children with diarrhoea in relation to their type of feeding.

Material & Methods: This cross-sectional observational study was conducted in Department of Pediatrics over a period of 2 years. Total of 200 children presenting to pediatric unit with acute diarrhoea under five years of age were selected.

Results: The mean age of the study participants was 25.05±18.12 months. The median age of the study participant was 18.12 (interquartile range=9.0-36.5) months. The minimum age was 1.1 months and the maximum age was 60 months. Majority of the children belongs to the age category of less than one year which was 48%. Out of 200 children, 60% were males and 40% were females. In electrolyte imbalance, majority of the participants had hyperkalemia which was 30% followed by 20% had hyponatremia, 15% had hypokalemia, 10% had hypernatremia and 1% had chloride level more than 108 mmol/l. Sodium levels, potassium levels and chloride levels were equally distributed in both the groups with the p value of more than 0.05.

Conclusion: With the exception of hypokalaemia, our investigation did not identify a statistically significant correlation between electrolyte abnormalities in pediatric diarrhoea and the manner of feeding. However, it is important to note that the need for exclusive breastfeeding and the continuation of breastfeeding for a period beyond two years continue to have a protective effect against the occurrence of acute diarrhoea in children.

Keywords: Electrolyte abnormalities, Acute diarrhoea, Type of feeding.

Introduction

Acute diarrhoea may be defined as any sudden and significant increase in frequency and/or decrease in consistency of the stool of an individual lasting less than two weeks. [1] Acute watery diarrhea is a leading cause of morbidity and mortality in under-five children. The data from the World Health Organization (WHO) and the United Nations Children's Fund showed that there are about 2 billion cases of diarrheal diseases reported annually worldwide, accounting for the deaths of over 1.9 (18%) million children under 5 years of age mostly from developing countries annually.[2] Diarrheal diseases account for 1 in 9 child deaths worldwide, making diarrhea the second leading cause of death among children under the age of five.[3] Early formula feeding and failure to breastfeed during first 6 months increases the risk of childhood diarrhea.[4]

Breast milk contains all anti-infective and essential nutrients necessary for children's growth and development. Human milk contains high concentrations of fucosylated glycans which are oligosaccharides that prevent pathogens from adhering to target receptors on the mucosal surface of gastrointestinal tract, thereby preventing many cases of moderate to severe diarrhea. [5] Cow's milk feeding and improper dilution of formula feeds also causes frequent diarrheal diseases in infants. Diarrhoea-related deaths may result from immediate and/or long term consequences of the disease. [6]

The immediate effects include fluid and electrolyte derangement with an upset in the body's acid-base regulation. Since extracellular fluid osmolality and volume are determined by sodium content, this ion plays a key role in water and electrolyte regulation. In this regard, the biochemical derangement in children with dehydration may be hyponatraemic, isonatraemic or hypernatraemic. [7] Other biochemical disturbances observed include

hypokalaemia and metabolic acidosis. Most of the diarrheal-related deaths may be attributable to a lack of potable water, poor hygiene and sanitation, and low immunization coverage, as well as inappropriate child rearing and behaviours. [8]

The main aim of our study is to relate the electrolyte disturbances in children with diarrhoea with breast feeding, formula feeding, cow's milk feeding and mixed feeding among the children.

Material & Methods

This cross-sectional observational study was conducted in Department of Pediatrics, N.M.C.H, Patna, Bihar, India over a period of 2 years. Total of 200 children presenting to pediatric unit with acute diarrhoea under five years of age were selected.

Inclusion Criteria: Children from one month to five years of age with history of loose stools.

Exclusive Criteria: Pneumonia and other systemic illness, history of loose stools more than 14 days and newborn with history of diarrhoea.

Methodology

After taking the detailed history and examination, type of feeding and an evaluation of degree of dehydration was done. The blood samples were taken for estimation of electrolyte levels, blood glucose and renal function analysis. Detailed history regarding type of feeding like breast feeding, formula feeding, cow's milk feeding was taken. Depending on the type of feeding the children with diarrhea were divided into two groups, breast feeding group who were given only breastfeeding and other feeding group who were given formula feeds, cow's milk and mixed feeding. History of exclusive breastfeeding was asked if child was more than six months. History regarding duration of breast feeding till two years of age was also asked if child was more than two years. The electrolyte abnormalities, degree of dehydration and renal parameters among the children were analyzed and compared with their type of feeding. The data collected was studied between breastfeeding and other feeding groups.

Statistical Analysis

All the collected data were analysed using Statistical software SPSS version 21.0. Continuous variables are reported as mean value ± standard deviation. The mean were compared using the independent-samples T test for two groups and one-way analysis of variance for more than two groups. The p value < 0.05 was considered to be statistically significant.

Results

Table 1: Age and gender distribution among study participants

Age category (years)	N	%
<1	96	48
>1 to 2	40	20
>2 to 5	64	32
Total	200	100
Mean age in months±SD	25.05 ±18.12	
Median age in months (IQR)	18.12 (IQR=9.0-36.5)	
Minimum age in months	1.1	
Maximum age in months	60	
Gender		
Male	120	60
Female	80	40
Total	200	100

The mean age of the study participants was 25.05±18.12 months. The median age of the study participant was 18.12 (inter quartile range=9.0-36.5) months. The minimum age was 1.1 months and the maximum age was 60 months. Majority of the children belongs to the age category of less than one year which was 48%. Out of 200 children, 60% were males and 40% were females.

Table 2: Electrolyte imbalance observed among study participants

Electrolyte imbalance	N	%
Sodium levels		
Hyponatremia (<135)	40	20
Normal	140	70
Hypernatremia (>145)	20	10
Potassium levels		
Hypokalemia (< 3.5)	30	15
Normal (3.5 to 4.5)	110	55
Hyperkalemia (> 4.5)	60	30

Chloride level		
<89	0	0
89 to 108	198	99
>108	2	1
Total	200	100

In electrolyte imbalance, majority of the participants had hyperkalemia which was 30% followed by 20% had hyponatremia, 15% had hypokalemia, 10% had hypernatremia and 1% had chloride level more than 108 mmol/l.

Table 3: Comparison between sodium levels, potassium levels and chloride levels with type of feeding

Sodium levels	Breast feeding group N=100	Other feeding group N=100
Hyponatremia (<135)	15 (15)	25 (25)
Normal	75 (75)	65 (65)
Hypernatremia (>145)	10 (10)	10 (5)
Potassium levels		
Hypokalemia (< 3.5)	5 (5)	25 (25)
Normal (3.5 to 4.5)	65 (65)	45 (45)
Hyperkalemia (> 4.5)	30 (30)	30 (30)
Chloride levels		
<89	0	0
89 to 108	98 (98)	100 (100)
>108	2 (2)	0

Out of 100 children in Breast feeding group, 15 (15%) had hyponatremia, 75 (75%) had normal sodium levels and 10 (10%) had hypernatremia. Among 100 children in other feeding groups 25 (25%) had hyponatremia, 65 (65%) had normal sodium levels and 5 (5%) had hypernatremia. Sodium levels were equally distributed in both the groups with the p value of more than 0.05. In breast feeding group, 5 (5%) had hypokalemia, 65 (65%) had normal potassium levels and 30 (30%) had hyperkalemia. Among 100 children in other feeding groups 25 (25%) had hypokalemia, 45 (45%) had normal potassium levels and 30 (30%) had hyperkalemia. The hypokalemia was significantly higher in other feeding groups when compared to breast feeding group with the p value of less than 0.05. Normal potassium level and hyperkalemia was equally distributed in both the groups with the p value of more than 0.05. 98 children (98%) had the chloride level between 89 to 108 mmol/l and 2 (2%) had chloride levels more than 108 mmol/l in the breast-feeding group. All the 100 children in other feeding group had normal chloride levels between 89 to 108 mmol/l. Chloride levels were equally distributed in two groups with the p value of more than 0.05.

Discussion

Diarrheal diseases remain a leading cause of preventable death especially among children under five in developing countries.[9] Diarrheal diseases account for 1 in 9 child deaths worldwide, making diarrhea the second leading cause of death among children under the age of five.[10] Early formula feeding and failure to breast feed during first 6 months increases the risk of childhood diarrhea. [11] Breast milk contains all anti-infective and essential nutrients necessary for children's growth and development. Evidence suggests that infants and young children who were primarily breastfed were less likely to experience diarrhea. The type of feeding and hygiene practices followed also reduced incidence and severity of diarrhea as suggested by some studies. [12] Human milk contains high concentrations of fucosylated glycans which are oligosaccharides that prevent pathogens from adhering to target receptors on the mucosal surface of gastrointestinal tract, thereby preventing many cases of moderate to severe diarrhea. Cow's milk feeding and improper dilution of formula feeds also causes frequent diarrheal diseases in infants. Most of the diarrheal-related deaths may be attributable to a lack of potable water, poor hygiene and sanitation, and low immunization coverage, as well as inappropriate child rearing and behaviours. [13]

The mean age of the study participants was 25.05 ± 18.12 months. The median age of the study participant was 18.12 (inter quartile range=9.0-36.5) months. The minimum age was 1.1 months and the maximum age was 60 months. Majority of the children belongs to the age category of less than one year which was 48%. Most of the cases seen in the current study were children under 2 years of age. This is in keeping with the incidence of diarrhea which has been reported to be highest in children aged 6 months–2 years. [14] This explains that children' of this age group are more prone for diarrheal incidence as compared with older age group. This finding is consistent with studies reported by Edward et al [15] and Degebasa et al [16] This could be explained by the fact that children older than 24 months are less prone for

diarrheal diseases than those younger to them as the younger age groups are usually undergoing complementary feeding during the time period of 6-23 months which paves way for the vulnerability of diarrheal disease causing infectious agents because of their under developed immunity.

Out of 200 children, 60% were males and 40% were females. In electrolyte imbalance, majority of the participants had hyperkalemia which was 30% followed by 20% had hyponatremia, 15% had hypokalemia, 10% had hypernatremia and 1% had chloride level more than 108 mmol/l. Though all the causes of mortality in the current study occurred in children that were exclusively breastfed, studies have shown that breastfed babies are more protected against diarrheal diseases as human breastmilk contains glycans including human milk oligosaccharides which are part of the immunological mechanism that accounts for the way in which human milk protects breastfed infants in addition to the fact that breastfeeding reduces the exposure to contaminated foods and contributes to adequate nutrition and hence, nonspecific immunity.[17]

Out of 100 children in Breast feeding group, 15 (15%) had hyponatremia, 75 (75%) had normal sodium levels and 10 (10%) had hypernatremia. Among 100 children in other feeding groups 25 (25%) had hyponatremia, 65 (65%) had normal sodium levels and 5 (5%) had hypernatremia. Sodium levels were equally distributed in both the groups with the p value of more than 0.05. In breast feeding group, 5 (5%) had hypokalemia, 65 (65%) had normal potassium levels and 30 (30%) had hyperkalemia. Among 100 children in other feeding groups 25 (25%) had hypokalemia, 45 (45%) had normal potassium levels and 30 (30%) had hyperkalemia. The hypokalemia was significantly higher in other feeding groups when compared to breast feeding group with the p value of less than 0.05. Normal potassium level and hyperkalemia was equally distributed in both the groups with the p value of more than 0.05. 98 children (98%) had the chloride level between 89 to 108 mmol/l and 2 (2%) had chloride levels more than 108 mmol/l in the breast-feeding group. All the 100 children in other feeding group had normal chloride levels between 89 to 108 mmol/l. Chloride levels were equally distributed in two groups with the p value of more than 0.05. This finding was contrast to the study by Banajeh et al [18] where hyponatremia was significantly more prevalent in infants who were exclusively bottle-fed compared with exclusively breastfed and among bottle-fed weaning children compared with weaning children who continued to breastfeed.

A close complex relationship exists between diarrhea, malnutrition and intestinal integrity as malnourished children have a greater susceptibility to infections, particularly gastrointestinal tract. Hence, with each diarrheal episode anorexia, reduced absorptive function, and mucosal damage, as well as nutrient exhaustion, occur. A significant proportion of the case fatality in the current study was children whose index illness of diarrhea coexited with various forms of malnutrition.

Conclusion

This research did not demonstrate a statistically significant correlation between electrolyte imbalances in diarrhea and the method of feeding in pediatric patients. Exclusive breastfeeding and breastfeeding till the age of two continues to provide protection against several infectious disorders, such as diarrhea, in children. The absence of medical intervention for a severe electrolyte imbalance poses a significant threat due to its potential to heighten the likelihood of neurological complications, such as seizures. Therefore, it is essential to promptly evaluate and treat these electrolyte imbalances in order to avoid the progression of severe dyselectrolytemia and its associated consequences.

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