ORIGINAL ARTICLE

Frequency and Outcome of Sodium Imbalance in Dehydrated Children Presenting with Acute Watery Diarrhea

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ABSTRACT

Background: Fluid, electrolytes and acid base disturbances are responsible for most deaths due to acute diarrhea in children. Thus early detection and prompt treatment of dehydration and electrolytes imbalances in children are significant. This study was conducted to determine frequency and outcome of sodium imbalance in dehydrated children presenting with acute watery diarrhea.
Aim: To determine Frequency and outcome of sodium imbalance in dehydrated children presenting with acute watery diarrhea.
Duration and settings: Department of Pediatrics, Sharif Medical City Lahore from 02-09-2017 to 01-08-2018.
Study design:Descriptive observational study
Methods: 230 cases meeting the inclusion criteria were included.After enrolling, 3ml of clotted venous blood sample was obtainedbefore rehydration and sent to laboratory for analysis of electrolytes. Type of sodium imbalance was assessed. All patients were treated with rehydration therapy. The outcome was measured in terms of response to therapy (within 24 hours or within 48 hours). Data was collected on prescribed Proforma. All the data collected was entered and analyzed.
Results: Out of 230 children with acute diarrhea and dehydration that included in this study, there were 61.30% children with isonatremic dehydration, 30.86% children with hyponatremic dehydration and 7.82% children had hypernatremic dehydration. 90.86% children showed response to rehydration therapy within 24 hours and 9.13% children showed response to rehydration therapy within 48 hours.
Conclusion: From the results of present study, it is concluded that frequency of isonatremic dehydration in children presenting with acute watery diarrhea is high i.e., 61.30% and response to rehydration therapy is good within 24 hours i.e 90.86%.
Keywords: Acute watery diarrhea; isonatremia; hypernatremia; hyponatremia;dehydration

INTRODUCTION

Dehydration, particularly from gastroenteritis, is a common pediatric emergency. Approximately 30 million children are affected annually, with 1.5 million presenting to outpatient care, 200,000 requiring hospitalizations, and 300 dying in the United States. Worldwide, according to the Centers for Disease Control and Prevention (CDC), for children younger than 5 years, the annual incidence of diarrheal illness is approximately 1.5 billion, while deaths are estimated between 1.5 and 2.5 million per year[1,2].

The TBW comprises approximately 70% of body weight in infants, 65% inchildren, and 60% in adults. Infants' and children's higher body water content, along with their higher metabolic rates and increased body surface area to mass index, contribute to their higher turnover of fluids and solute Therefore, infants and children require proportionally greater volumes of water than adults to maintain their fluid equilibrium and are moresusceptible to volume depletion .3Variations in serum sodium reflect the composition of the fluids lost and have different pathophysiologic effects. Isonatremic (isotonic) dehydration occurs as a result of equal solute and water losses, thus maintaining a normal sodium concentration of 135 to 150 mEq/L (135 to 150mmol/L). This is the most common presentation of dehydration and has the best prognosis. In general, oral rehydration can safely and effectively restore intravascular volume in children with mild-to-moderate isonatremic dehydration[4,5]. Hyponatremic (hypotonic) dehydration occurs when the lost fluid contains more sodium than the blood (loss of hypertonic fluid). Relatively more sodium than water is lost. Because the serum sodium is low, intravascular water shifts to the extravascular space, exaggerating intravascular volume depletion for a given amount of total body water loss. Hyponatremic dehydration most typically occurs in older infants and children with gastrointestinal infections. These children are often given fluids with low sodium content such as water, juice, ginger ale, sodas, or tea[6,7]. Hypernatremic (hypertonic) dehydration is defined as serum sodium greater than 150mEq/L (150mmol/L). Despite elevated sodium concentrations, the child actually has total body sodium deficiency, but the water loss exceeds the sodium loss. It is most commonly seen in young infants receiving inadequate water replacement, typically associated with diarrheal illnesses or poor breastfeeding. Because the intravascular contents are hypertonic, fluid shifts from the cells into the intravascular space. Thus, the children may be less hemodynamically compromised, resulting in underestimation of the degree of dehydration. In general, an additional 3% to 5% degree of dehydration should be added to the clinical estimate. The major concern is cerebral cellulars dehydration in the presence of

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hypertonicity. Resulting brain shrinkage can cause rupture of bridging veins, leading to subdural, subarachnoid, and intraparenchymal hemorrhage. In addition, thrombosis of the small veins or dural sinuses can occur. Isonatremic and hyponatremic volume depletion states may be treated with normal saline or other isotonic solutions. The goal for correction rates for either hyponatremic or hypernatremic patients should be no more than 0.5mEq/L/h or no more than 8mEq/L per 24-hour period to prevent the devastating CNS complications of over-rapid correction (central pontinemyelinolysis and cerebral edema). Full correction of severe sodium abnormalities usually should be staged over 24-48 hours or longer.Although a potassium deficit is present in all cases of volume depletion, it is not usually clinically significant

MATERIALS AND METHODS

This descriptive case series study was conducted at the In-patient department of pediatric unit, Sharif Medical City Hospital Lahore from 2nd September 2017 to 1st March 2018 . Sample size of 230 cases was calculated with 95% confidence level and 3.5% margin of error with expected frequency of hypernatremic dehydration in acute diarrhea of 7.9%.Sampletechnique was non-probability consecutive sampling.

Inclusion criteria: All children aged 2 months to 5 years admitted in the pediatric ward of Sharif medical city with acute diarrhea and dehydration

Exclusion criteria:

1. Children with chronic diarrhea (more than 14 days)
2. Childrenwith other chronic illnesses e.g. liver disease (AST more than 40 IU) (ALT more than 40IU), Kidney disease (creatinine more than 1.2gm/dL), cardiac problems, metabolic and endocrinal disorders.

Data Collection: In this study we took 230 cases from pediatric department of Sharif medical city Lahore who met the inclusion criteria. The demographic information like name, age, sex, address was obtained after taking informed consent from attendants or parents of the children. After enrolling, 3ml of venous blood sample was obtained in clotted vial with the help of staff nurse before rehydration and sent to laboratory for analysis on electrolyte and arterial blood gases analyzer. Type of sodium imbalance was assessed as per operational definition. All patients were treated with rehydration therapy. The outcome was measuredin terms of response to therapy (within 24 hours or within 48 hours) as per operational definition. All data was collected by researcher herself on prescribed Performa.

Data analysis: All the data collected was entered and analyzed using SPSS version 19. For quantitative variables like age and sodium imbalance mean±S.D were used. For qualitative variables like gender and dehydration types (hyponatremic, hypernatremic and isonatremic) and outcome, frequency and percentage were used. Effect modifiers like age, gender and weight were controlled through stratification of data. Chi square test was applied ($p < 0.05$ was taken as significant).

RESULTS

Two hundred and thirty children less than 5 years of age with acute diarrhea and dehydration were included in the study.Of the 230 children with acute diarrhea and dehydration included in the study, there were 71(30.86%) children whose sodium level was less than 135mEq/l. There were 141(61.30%) children whose sodium level was between 135 to 150mEq/l. There were 18(7.82%) children whose sodium level was more than 150mEq/l. The mean sodium level in children presenting with acute diarrhea and dehydration was 132.05±5.98mEq/l. Out of 230 children with acute diarrhea and dehydration that included in our study, there were 209(90.86%) children those showed response to rehydration therapy within 24 hours and 21 (9.13%) children showed their response to rehydration within 48 hours.

Sodium level (mEq/L)	**Number of patients**	
	Frequency	**%age**
<135	71	30.86
135-150	141	61.30
>150	18	7.82
MEAN + SD	132.05 +5.98	
OUTCOME (Response to rehydration therapy)		
Within 24 hours	209	90.86
Within 48 hours	21	9.13

DISCUSSION

In this prospective clinical study of 230 patients, we determined the frequency and outcome of various types of sodium imbalance in children presenting with acute diarrhea and dehydration. (Age 2 months- 5 years). In our study, there were 61.30% children with isonatremic dehydration, 30.86% children with hyponatremic dehydration and 7.82% children had hypernatremic dehydration. While in a study by Shah BH et al, Isonatremic dehydration was seen in 37%, hyponatremia in 62% and hypernatremic dehydration was seen in 2% children.8 In a study by Omer R et al, hyponatremia was seenin 10.3% patients, isonatremia in 77.8% and hypernatremia in 11.9%. 9105 In a study by Akhter S et al, hypernatremia was seen in 14±0.64% children with diarrhea. Hyponatraemic dehydration was the commonest type of dehydration observed by Shah GS et al. among Nepalese children i.e., 56%.10There were 90.86% children those showed response to rehydration therapy within 24 hours while 9.13% children showed their response to rehydration within 48 hours in our study. The observation was almost similar to the results obtained by Shah BH et al, 92% of hyponatremia was corrected within 24 hours of starting the therapy.

CONCLUSION

From the results of present study, it is concluded that frequency of isonatremic dehydration in children presenting with acute watery diarrhea is high i.e., 61.30% and

response to rehydration therapy is good within 24 hours i.e., 90.86%. Dehydration is common complication seen in acute gastroenteritis among children which leads to long term morbidity and sometimes mortality which is easily preventableby simple measures.

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