

## STUDY OF ELECTROLYTE IMBALANCE IN CHILDREN SUFFERING FROM ACUTE GASTROENTERITIS OF UNDER 5 AGE GROUP

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### ABSTRACT

#### BACKGROUND

Acute Gastroenteritis is a leading cause of illness and death amongst children in developing countries. Serum electrolyte disturbances are common in under five children with acute gastroenteritis resulting in morbidity and mortality.

The aim of the study was to assess the type and prevalence of electrolyte imbalance in under five children with acute gastroenteritis.

#### MATERIALS AND METHODS

This was a descriptive, hospital based cross-sectional study of children below five years age group with dehydration due to acute gastroenteritis. Serum electrolyte profiles were determined.

#### RESULTS

Out of 80 children studied, 44 (55%) children were aged below 12 months, 20 (25%) children were between 13 to 36 months, and 16 (20%) children were between 3 to 5 years. The frequencies of various types of dehydration were hyponatraemic in 49 (62.5%) children, isonatremic in 31 (38.75%) children and no case of hypernatremia. Hypokalaemia was observed in 21 (26.5%) children. The overall case fatality rate was 6 (7.5%). All the children who died, were below 36 months. All were acidotic. Two had features of acute renal failure. Others died because of associated infection and peripheral circulatory failure.

#### CONCLUSION

Hyponatremia, Hypokalaemia were the common electrolyte abnormalities in acute gastroenteritis and were responsible for most deaths.

#### KEYWORDS

Acute Gastroenteritis, Electrolyte Imbalance, Hyponatremia, Hypokalaemia.

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#### BACKGROUND

Diarrhoea is still one of the leading causes of morbidity and mortality in children around the world.<sup>1</sup> WHO estimated that worldwide, 1 child dies of diarrhoea every 6 seconds.<sup>2</sup> In India, at least 1.5 million under-5 children die every year due to acute diarrhoea.<sup>3</sup> Diarrhoea-related deaths may result from immediate or long term consequences of the disease.<sup>4</sup> 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. An analysis of UNICEF (1984) shows that 60-70% of children who die from diarrhoea die from dehydration.

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It is estimated that in Africa, Latin America and Asia 1 billion cases occur each year and 4.6 million deaths due to diarrhoea.<sup>5</sup> In developing countries it is amongst the top 5 causes of morbidity and mortality while in the developed countries the mortality is low, and morbidity is variable.<sup>6</sup> Desai et al have stated that attack rate of diarrhoea is 150-200 episodes per 100 children per year. Fatality rate is 1-4% giving a death rate of 20-55 per 1000 children annually. There occurs approximately 450 million episodes of diarrhoea every year; over 80% of acute cases belong to age group from 6 months to 3 years.<sup>7</sup>

Banerjee et al have shown that in India diarrheal diseases are the third most important cause of infant mortality and accounts for 9.4% of total infant deaths in the country. An analysis regarding diarrheal disease states in urban and rural areas<sup>8</sup> of India conducted and published by D.G. Health Service, Govt. of India (1986) has shown that annual incidence of 1-6 episodes for urban and about 4 episodes for rural children. The mortality in children less than 5 years of age is 20-32%. The cause of diarrhoea could be infective, non-infective or may be due to emotional factors.

Broadly speaking majority of the diarrhoea in paediatric practice is acute in nature (80-90%),<sup>9</sup> a few are recurrent,



and fewer still are chronic. In this regard, the biochemical derangement in children with dehydration may be hyponatraemic, isonatremic or hypernatraemic.<sup>10</sup> Other biochemical disturbances observed include hypokalaemia and metabolic acidosis. However, in clinical settings, the degree of dehydration is often classified as mild, moderate or severe based on the estimated fluid loss and other clinical parameters.<sup>11</sup> Dehydration is the most frequent and dangerous complication responsible for morbidity and mortality in children with acute diarrhoeal disease.<sup>12</sup> A study conducted by Sharma et.al. showed that electrolyte disturbances in acute gastroenteritis was associated with increased morbidity, with hyponatraemic dehydration in 52.3% cases.<sup>13</sup> No recent studies exist regarding the electrolyte disturbances occurring in a child suffering from Acute gastroenteritis. Also, there are no specific studies describing the clinical features associated with Hyponatraemic dehydration and Isonatremic dehydration. In the present study, an attempt has been made to outline the spectrum of electrolyte disturbances in children suffering from Acute gastroenteritis with moderate to severe dehydration.

**MATERIALS AND METHODS**

Eighty children suffering from acute gastroenteritis with dehydration admitted to the Paediatrics Department of King George Hospital, Visakhapatnam, A.P. were included in the present study. Detailed history, examination and investigations were recorded in specially designed Proforma. Written informed consent was taken from the parent prior to the study. These children were clinically evaluated to assess the severity of dehydration according to WHO criteria.<sup>14</sup> In all these patients, serum sodium, serum potassium were estimated before starting the treatment. 3 ml of venous blood was collected under strict aseptic measures which were kept in centrifuge tubes for estimation of serum electrolytes.

Based on the serum sodium concentration the type of dehydration has been conventionally classified and the subjects were categorized into hyponatraemic (serum sodium < 130 mEq/l), isonatremic (serum sodium between 130-150 mEq/l) and hypernatremia (serum sodium > 150 mEq/l).<sup>15</sup> Hypokalaemia was taken as serum potassium <3.5 mEq/l. The data were analysed using SPSS software. Descriptive statistics like frequencies, means, standard deviations, percentages were determined as appropriate for the variables. Student t test was used in ascertaining the significance of differences between two means with P value <0.05.

**RESULTS**

A total of 80 patients were included in the study. Out of the total 80 cases of gastroenteritis, males were 65% and females were 35%. The cases of gastroenteritis are significantly more in the males in our study.

Gender	Number (N=80)	Percentage (%)
Male	52	65.0%
Female	28	35.0%

**Table 1. Distribution of Acute Gastroenteritis Patients According to their Gender**

According to age, 44 patients (55%) were between 1 month to 12 months, 20 patients (25%) were between 13 to 36 months and 16 patients (20%) were between 3 to 5 years.

Age Group	Number (N=80)	Percentage (%)
0-12 months	44	55.0%
13-36 months	20	25.0%
3-5 years	16	20.0%

**Table 2. Distribution of Acute Gastroenteritis Patients According to their Age**

The means, SD of the serum electrolytes concentrations are shown in Table III. The distribution of the types of dehydration among the subjects, based on serum sodium concentration, was as follows: Hyponatraemic dehydration in 49 (61.25%) children, isonatremic dehydration in 31 (38.75%), and no case of hypernatraemic dehydration. out of 80 subjects, 21 children (26.25%) had hypokalaemia, 59 children (73.75%) had normokalaemia.

Serum Electrolytes	Mean (SD)
Serum sodium	128.37(5.65)
Serum potassium	3.49(0.51)

**Table 3. Mean Serum Electrolyte Levels of 80 Children**

SD- Standard Deviation

Age Group	Mean Serum Sodium (SD)	Mean Serum Potassium (SD)
0-12 months	126.64(5.57)	3.31(0.56)
13-36 months	130.17(4.77)	3.68(0.48)
3-5 years	130.85(5.68)	3.65(0.33)

**Table 4. Mean Serum Electrolytes in Under-Five Age Group Children**

SD- Standard Deviation

**DISCUSSION**

The high incidence of diarrhoeal disorders requiring patient hospitalisation confirms the immense importance of acute gastroenteritis with regard to public health. The prevalence of viral aetiology in India has been found to vary in the range 5-71% in hospitalised children aged less than 5 years with acute gastroenteritis. The loss of fluid in diarrheal disorders is associated with loss of many electrolytes. It mainly includes sodium, potassium and bicarbonate. The amount of loss of these electrolytes is influenced by the amount and type of fluid lost from the body by the kidneys. Data from the present study indicated that hyponatremia was the most common electrolyte abnormality encountered in the under-

five Indian children with severe dehydration due to acute gastroenteritis followed by isonatremia and hypokalaemia. The incidence of diarrhoea and hyponatraemic dehydration with hypokalaemia was found to be more common among infants (55%). The higher incidence of diarrhoea had also been reported by other workers.<sup>16,17</sup> Newborns and infants because of their immature immunological response are particularly susceptible to infection especially if they are not breast fed. Moreover, they are easily prone to dehydration and electrolyte imbalance because of greater water content and increased insensible water loss from their body.<sup>18</sup>

The predominance of hyponatremia in dehydrated children with acute diarrhoea has also been reported in other studies. Sharma et al found hyponatremia in 52.3% of children with diarrhoea and dehydration, whereas isonatremic dehydration was seen in 47.75% of children. In the present study, hyponatraemic dehydration was seen in 61.25% children, whereas dehydration was seen in 38.75%, and there was no case of hypernatraemic dehydration.

The pathogenesis of hyponatremia in diarrhoea is due to a combination of sodium and water loss and water retention to compensate for volume depletion.<sup>19</sup> In developed countries hypernatremia is commonest electrolyte imbalance in children suffering from diarrhoea with dehydration. Ironside et al found hypernatremia in 63% children and hyponatremia in 55% children.<sup>20</sup> This is probably because of concentrated feeding formula being given to them.

Different studies suggested that hypokalaemia is a common problem in children with acute diarrhoea. In the present study, 26.25% children had hypokalaemia and 73.75% children had normokalaemia and none of the cases had hyperkalaemia. These findings correlated with the study of other workers. Gastric secretions contain up to 20 mEq/L of potassium and diarrheal fluid contains 10–80 mEq/L.<sup>21</sup> Both the metabolic alkalosis which accompanies persistent vomiting and the dehydration resulting from vomiting and/or diarrhoea stimulate aldosterone release. Aldosterone excess further potentiates hypokalemia<sup>22</sup>, there by compounding the potassium loss due to vomiting and diarrhoea.

In the present study out of 80 children, six cases expired, one case died probably because of associated encephalitis. Two cases had features evident of acute renal failure. Choudary V.P. et al studied the renal status in children suffering from acute gastroenteritis. In their study acute renal failure was diagnosed if there was persistent anuria or oliguria during the hospital stay (urinary output 300 ml/m<sup>2</sup>/24hrs) with rise in blood urea (>100 mg%), serum creatinine and serum potassium concentration. The incidence of acute renal failure was as high as 5.7% in their study.<sup>23</sup>

Further Choudary et al observed that among the cases of acute renal failure, gastroenteritis with dehydration alone contributed to 27.4% of all such cases in paediatric age group.<sup>24</sup> In the present study, septicaemia and peripheral circulatory failure was probably responsible for the death of other cases. Therefore, if septicaemia is associated, proper

antibiotics should be started simultaneously in combination with dehydration therapy.

## CONCLUSION

Hyponatraemia, hypokalaemia, and metabolic acidosis were the leading electrolyte abnormalities in acute diarrheal illnesses and were responsible for most diarrhoea-related deaths. Therefore, isotonic saline could be started in all cases of diarrhoea with dehydration without waiting for serum sodium reports. Since there is loss of potassium and acidosis, Ringer's lactate solution should be considered as preferred solution for initial therapy in all cases of diarrhoea with dehydration, especially in developing countries where hyponatraemic dehydration is more prevalent and determination of serum electrolytes prior to therapy is not feasible. In all cases of diarrhoea with dehydration, associated infection and renal failure should be kept in mind and the condition should be dealt with accordingly.

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