

SERUM ELECTROLYTES CHANGES IN MALNOURISHED CHILDREN WITH DIARRHOEA

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ABSTRACT

Objective: To determine the frequency of electrolyte disturbances in malnourished children with and without diarrhea and whether these findings have therapeutic value or not.

Methodology: It is a descriptive study conducted at pediatric Unit- II LUH Hyderabad, from 1st August to 31st September 2004. One hundred children of protein-calorie-malnutrition between 6 months to 5 year of age of either sex who were admitted due to diarrhoea, failure to thrive, acute respiratory infection, malaria, anemia, cardiac failure and feeding problems were included in the study. On the basis of history, physical examination and anthropometrics measurement they were divided into Group A patients (n=64) who were malnourished but had diarrhoea and Group B patients (n=36) who were also malnourished and had no diarrhoea. Serum electrolytes were done in patients of both groups and the results were analyzed statistically.

Result: Analysis of serum electrolyte in both groups revealed that hypokalemia, hyponatremia and low serum bicarbonate were seen more frequently in patients of group A as compared to group B. In group A hypokalemia was seen in 40 patients (62.5%) while it was observed in 8 patients (22.22%) in group B ($p < 0.001$), hyponatremia was seen in 17 patients (26.56%) in group A and in 5 patients (13.88%) in group B ($p < 0.001$). In group A 41 patients (64%) had low serum bicarbonate while in group B only 15 patients (41.66%) had low serum bicarbonate value ($p < 0.001$).

Conclusion: Electrolyte changes were commonly seen in grade II and III malnourished patients particularly who presented with diarrhoeal episode of variable duration. If these changes are diagnosed in time and treated appropriately the morbidity and mortality could be decreased.

KEY WORDS: Malnutrition, Diarrhoea, Electrolyte changes.

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INTRODUCTION

Malnutrition is a major problem globally.¹ It interacts with diarrhoea in a vicious circle leading to high morbidity and mortality in children, and is a complicating factor for other illnesses in developing countries. Malnourished children have more severe diarrhoea, which lasts longer. The prevalence of diarrhoea is 5-7 times more in malnourished as compared to normal children and its severity is 3 to 4 times greater in malnourished children as compared to normal children.²

In malnutrition various abnormalities occur in body electrolytes, which become more marked if accompanied by diarrhoeal diseases. Electrolytes are ionized molecules found through out the blood, tissues and cells of the

body. Their mole is either positive or negative and they conduct an electric current and help to balance pH and acid base level in the body. They also facilitate the passage of fluid between and within cells through process of osmosis and play a part in regulating the function of neuromuscular, endocrine and excretory systems. The main serum electrolytes are:

1. Sodium- It helps to balance fluid level in the body and facilitate neuron functioning.
2. Potassium- It is the main component of cellular fluid and helps to regulate neuromuscular function and osmotic pressure.
3. Bicarbonate- It carries negative charge and assists in regulation of blood pH. Increase or decrease in bicarbonate cause acid base disorder.³

Various abnormalities in body electrolytes occur in malnutrition. Most common electrolyte abnormalities are those that involve sodium, potassium, bicarbonate and water. In malnutrition with edematous state body water content is increased accompanied by sodium retention that is primarily extra cellular but serum sodium level is reduced in most children with malnutrition masking the sodium overload. These levels may be low due to associated diarrhea. Total body potassium is decreased in all malnourished as much as 25% in overt malnutrition, due to decreased intake and poor muscle mass. Potassium is predominantly intracellular ion needed for maintaining homeostasis integral to normal cellular function but only 2% of body content is in extra cellular fluid so plasma potassium is a poor indicator of total amount in the body. However plasma potassium concentration has importance in immediate therapy in case of life threatening hypokalemia. In malnutrition sub clinical deficiency of potassium may be present with out any clinical feature but these children are at risk of hypokalemia during diarrhoeal disease, which makes the clinical picture of deficiency obvious and patient presents with muscle weakness, hypotonia, apathy, abdominal distention, paralytic illness and serious cardiac arrhythmias.^{4,7} Both malnutrition and electrolyte disturbances are considered to be

risk factors for death among children with diarrhea.⁸⁻¹⁰

The purpose of this study was to determine the serum electrolyte status in malnourished children with and without diarrhoea, so that serum electrolyte disturbances could be managed to reduce the risk of death or disability.

METHODOLOGY

This study of 100 cases of protein calorie malnutrition was conducted in the pediatric department of Liaquat University Hospital Hyderabad from 1st August to 30th September 2004. Each child was assessed by taking detailed history from mother/caregiver, performing physical examination, Anthropometric measurements such as weight, height, accipitofrontal circumference and investigations especially serum electrolytes .The nutritional status of these children was assessed by Modified Gomez classification using weight for age as reference and they were categorized into grade I malnutrition (weight 70%-80% of expected weight for age), grade II malnutrition (weight 60%-70% of expected weight for age) and grade III malnutrition (weight <60% of expected weight for age). All the information's was recorded on a specified proforma and the data was analyzed statistically through SPSS version 10.0 software program.

Inclusion Criteria: Malnourished children between 6 months to 5 year of age, with or without diarrhea of variable duration.

Exclusion criteria: Malnourished children under 6 months or older than 5 year. Malnourished children who expired before complete investigations were not included in this study.

RESULT

Out of 100 children 57 were male and 43 females. As regards the nutritional status 12 children were in grade I, 27 were in grade II and 61 were in grade III malnutrition (Table-I).

The patients were divided into two groups (Table-II). Group A includes sixty-four children who had diarrhoea of variable duration and

Table-I: Protein calorie malnutrition status

SEX	PCM I	PCM II	PCM III	Total
Male	9 (15.78%)	14(24.56%)	34(59.64%)	57
Female	3 (6.97%)	13(30.23%)	27(62.79%)	43
Total	12 (12%)	27 (27%)	61(61%)	100

Group B, which includes thirty-six malnourished children who had no diarrhoea. Analysis of Serum electrolytes revealed that hyponatremia i.e. serum sodium <130meq/l was seen in 22 children, out of them 17 had diarrhoea ($p < 0.001$) indicating that diarrhoea has lowering effect on serum sodium while hypernatremia i.e. serum sodium > 150meq/l was present in 3 children and only one of them had diarrhoea ($p < 0.414$) Isonatremia was seen in 75 children out of them 47 had diarrhoea. In Group A 40 children had hypokalemia i.e serum potassium < 3.5meq/l and in Group B only 8 children had low K. ($p < 0.001$) indicating that diarrhoeal illness lowers the K more often as compared to Na. Serum bicarbonate was found low in 56 children. Out of them 41 children were in Group A and 15 were in Group B ($p < 0.001$) (Table-II).

Most cases of electrolyte disturbance were seen in Grade III (Table-III) as compared to Grade I and II and in those who had diarrhoea of variable duration. Hypernatremia was seen in 3 children with Grade II malnutrition, one of whom had diarrhoea.

DISCUSSION

Diarrhoea continues to be a serious problem in our children and may be fatal when superimposed upon malnutrition. It results in large losses of water and electrolyte especially sodium, potassium and bicarbonate.¹¹ Sodium

chloride and bicarbonate are the major ions contributing to osmolality of extracellular fluid while potassium is in low concentration but nevertheless is essential for normal cell function. Bicarbonate is the major ion that regulates the pH of extracellular fluid. The concentrations of individual ion influence the properties and behavior of excitable membrane such as nerve cell and performance of many intracellular enzymes. In malnutrition serum electrolytes do not reflect the body content but only the circulating concentration, thus high serum potassium mask intracellular potassium deficiency while low serum sodium mask sodium overload but they have importance in immediate therapy in cases of life threatening situation.¹² Studies show that malnutrition is associated with increased incidence and duration of acute diarrhoea and is a risk factor for diarrhoea and respiratory mortality.¹³⁻¹⁸ In severe malnutrition significant risk factor for fatal diarrhoea includes hyponatremia, hypokalemia and metabolic acidosis.⁸

In our study electrolyte disturbance were mostly seen in Grade III malnutrition and the electrolyte disturbance mostly affect the serum potassium seen in 48(48%) and bicarbonate seen in 56(56%) cases while sodium imbalance is seen in 25(25%) cases. The study also shows that hypokalemia, acidosis and hyponatremia were seen more frequently in those who had diarrhoea as compared to those who had no diarrhoea.

A study from Bangladesh reported that incidence of hyponatremia was directly related to the degree of malnutrition and a serious complication of diarrhoea with case fatality rate of 10.1% as compared to isonatremia or

Table-II: Electrolyte Disturbances in two Groups

Electrolyte Disturbances	Group A (n=64)	Group B (n=36)	P. Value	Total (n=100)
Hypokalemia	40 (62.5%)	8(22.22%)	0.000*	48(48%)
Hyponatremia	17(26.56%)	5(13.88%)	0.000*	22(22%)
Hypernatremia	1(1.56%)	2 (5.55%)	0.414	3 (3%)
Acidosis	41 (64%)	15(41.66%)	0.000*	56(56%)

* $P < 0.05$ considered as statistically significant

Table-III: Electrolyte disturbances according to PCM grades

Serum electrolyte	Nutritional Status							
	PCM I		PCM II		PCM III		Total	
	M	F	M	F	M	F	M	F
S. Sodium								
Isonatremia	9	3	11	8	21	23	41	34
Hponatremia	0	0	3	2	13	4	16	6
Hypernatremia	0	0	0	3	0	0	0	3
S. Potassium								
Normokalemia	6	2	7	9	13	15	26	26
Hypokalemia	3	1	7	4	21	12	31	17
S. Bicarbonate								
Normal S.Hco ₃	5	1	5	5	15	13	25	19
Mild Acidosis S.HCO ₃ 16-20 meq/l	2	0	5	4	13	7	20	11
Moderate Acidosis S.HCO ₃ 0-15 meq/l	2	1	3	4	5	5	10	10
Sever Acidosis S.HCO ₃ <10 meq/l	0	1	0	1	2	1	2	3

hypernatremia.¹⁹ Malnourished children have poorer sodium balance during acute diarrhoea and they lose more sodium in their stool and urine during diarrhoea so that their total body sodium balance is diminished.²⁰ In our study hypernatremia was present in 3 children. Hypernatremia in association with malnutrition and diarrhoea is associated with risk of neurological damage and high mortality.²¹

Hypokalemia alters function of several organs and prominently affects the cardiovascular system, neurological system, muscle and kidney. In profound potassium deficiency muscle paralysis can occur.²² Ortuno et al reported hypokalemic induced paralysis secondary to acute diarrhoea in their case series.²³ Hypokalemia may be sub clinical in malnourished children but during diarrhoeal illness it becomes obvious clinically and manifests as hypotonia, abdominal distension, paralytic ileus, cardiac arrhythmia and respiratory distress. Our study also confirms that hypokalemia is more marked when there is associated diarrhoea. In a study by Rehana 37% children with acute diarrhea were found to be hypokalemic.²⁴

In our study reduced serum bicarbonate was present in 56% of cases; reduced serum bicarbonate has been found more often in infants with prolonged diarrhoea and underlying malnutrition.²⁵

CONCLUSION

It is concluded that electrolyte disturbances in malnourished children may be sub clinical but become obvious during diarrhoeal illness and measurement of Serum electrolyte is helpful for immediate therapy to avoid serious life threatening situation.

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