ORIGINAL ARTICLE

The Serum Electrolyte Imbalance in Children with Severe Acute Malnutrition

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ABSTRACT

Objective: To analyze the serum electrolyte imbalance in children with severe acute malnutrition (SAM) aged 1-59 months.

Study Design: It was a cross sectional study.

Place and Duration of Study: Six months from 1st March 2018 to 30th August 2018 at Nutrition Stabilization Centre of The Children's Hospital and Institute of Child Health Multan.

Materials and Methods: All the children between age group 1-59 months and admitted in Stabilization Centre of The Hospital and Institute of Child Health Multan with diagnosis of severe acute malnutrition during the study duration were included in this study. After inclusion criteria fulfilled sample was collected from 100 different patients and sent to Pathology department of Children's Hospital and Institute of Child Health Multan for biochemical assessment. The serum was analyzed for Mg^{2+}, Ca^{2+}, K^{+} and Na^{+} by spectrophotometric method. All the data was entered and analyzed by using SPSS version 21. The percentages were calculated through SPSS.

Results: Total 100 children with severe acute malnutrition were included in current study. 60 (60%) were male and 40 (40%) were female, mean age reported was 23.65 months. There were 66% cases presented with diarrhea. Hypokalemia was found in 23 (23%) children and hyponatremia was present in 28 (28%) children. Mean of sodium & potassium were 138.96 (8.692) and 3.06 ($\pm$1.7517) respectively. Mean (S.D) of calcium and magnesium were 8.51 (1.58) and 2.23 (2.38) respectively.

Conclusion: Electrolyte imbalance is common in children with severe acute malnutrition with or without diarrhea. Determination of electrolyte profile of children with severe acute malnutrition admitted at stabilization centers in Pakistan should be ensured to reduce the mortality and morbidity.

Key Words: *Diarrhea, Electrolytes Imbalance, Severe Acute Malnutrition (SAM).*

Introduction

Malnutrition is the big contributor of illness in children worldwide.[1] Malnutrition especially under nutrition is the cause of mortality and morbidity and results in 45% of child mortality (under 5 years of age) worldwide.[2] Pakistan is the fifth country having higher cases of Severe Acute Malnutrition.[3]

Severe acute malnutrition leads to major complications in the body along with electrolyte imbalances which may worsen with diarrhea.[4] In a healthy child, sodium potassium pump exists, which maintains the potassium concentration in the cell by pumping sodium out and potassium in to the cell. When a child is suffering from Severe Acute Malnutrition, the sodium potassium movement become impaired. The level of sodium inside the cell became high and potassium is lost. When the child is treated, Na+, K+ levels are maintained. Therefore, feeding must be very slow otherwise it will cause fluid overload, metabolic disturbances and system will be disturbed. Magnesium is essential for potassium to enter the cell. Potassium and magnesium are recommended according to World Health Organization (WHO) 3-4mmol/kg/day and 0.4-0.6mmol/kg/day respectively.[5]

The children with Severe Acute Malnutrition occasionally suffer from diarrhea which leads to the electrolyte imbalance.[6] The children suffering from Severe Acute Malnutrition may have low serum level of potassium (hypokalemia), high level of sodium (hypernatremia) and altered level of calcium. Rehydration Solution for Severely Malnourished Children (ReSoMal) is recommended which is less in

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sodium and more in potassium. Serum electrolyte imbalances in SAM children can be due to numerous reasons but are more evident during diarrhea.[7]

The malnourished children are more susceptible to morbidities and mortalities related to electrolyte balance. The findings of this study will help to determine the extent of electrolyte imbalance in children suffering from SAM and further researches can be conducted for detailed analysis. The purpose of current study was to analyze the serum electrolyte imbalance in children with severe acute malnutrition (SAM) aged 1-59 months admitted to The Children's Hospital and Institute of Child Health Multan.

Materials and Methods

The current study was cross sectional study, conducted in Nutrition Stabilization Centre of The Children's Hospital and Institute of Child Health Multan from March 2018 to August 2018. Simple random sampling technique was used. All the children between age 1-59 months and admitted in Stabilization Centre of The Children's Hospital and Institute of Child Health Multan during the duration of study period and diagnosed with severe acute malnutrition were included in this study. A total of 110 children were admitted during the study period. Severe Acute Malnutrition was defined as children having mid upper arm circumference less than 11.5cm, weight-for-height/length ratio less than -3SD and bilateral edema or anyone out of above. All Children admitted with severe acute malnutrition aged between 1-59 months with or without diarrhea were included in this study. The study was started after getting permission from IRB committee of the hospital. Written consent was taken from the parents/guardians of the admitted patients. Out of 110 patients only 100 gave consent and were thus enrolled for the study. The children whose parents refused to give consent were excluded from this study.

A self-made questionnaire was designed by the principal researcher and filled by the trained nursing staff of stabilization center. The demographic data (Age, Gender, and Name) was collected. Anthropometric assessment (Weight, height, MUAC, Weight/Height or Length Ratio) was done and noted by the nurses. About 2ml blood sample was collected from 100 patients admitted in Stabilization Centre ward and sent to Pathology department of Children's Hospital and Institute of Child Health Multan for biochemical assessment. Sodium and potassium analysis were performed by using patient's serum on a fully automated Electrolyte Analyzer Diestro 103 AP, that work on the principle of ion selective electrode (ISE) while serum calcium and magnesium levels were measured on a fully automated chemistry analyzer Beckman Coulter AU-680, that works on the principle of Spectrophotometry. The biochemical assessment was performed by lab technicians of the pathology department and results were recorded on the questionnaire by the nurses. The data collected was nonparametric.

All data was computed and analyzed by using SPSS version 21. Descriptive cross-sectional analysis of complete data was analyzed, and results are reported as frequencies and percentages. Mean SD and averages were calculated where required.

Results

Total 100 children with severe acute malnutrition were included in current study. 60 (60%) were male and the mean age in months was 23.65. there were 66% cases presented with diarrhea. Mostly children 93 (93%) belong to poor socio-economic status (Table I).

The serum level of potassium was low in 23 (23%) and high in 12 (12%) patients. The serum level of potassium was normal in 65 (65%) children.

The serum level of sodium was low in 28 (28%) and high in 15 (15%). The serum level of potassium was normal in 57 (57%) children.

The serum level of magnesium was low in 16 (16%). The serum level of Mg^{2+} was normal in 73 (73%) children.

The serum level of calcium was low in 28(28%) and high in 3 (3%). The serum level of potassium was normal in 69 (69%) children (Table II). The mean serum potassium and sodium was 3.06 ± 1.75 mmol/L and 138.96 ± mmol/L respectively. (Table III)

Discussion

Current study was intended to explain the electrolyte profile with severe acute malnutrition, admitted in Stabilization Centre of The Children's Hospital and Institute of Child Health Multan and their age were 1-59 months. This age group is very critical group because weaning is initiated, and children have higher risk of developing severe acute malnutrition. According to the findings of this study, in severe

Table I: Gender, Age, Socio-Economic Status of Children with SAM (N= 100)

Characteristics	Total Count (n=100)	Percentage (%)
Gender		
Male	60	60
Female	40	40
Age		
Less than 6 months	34	34
Greater than 6 months	66	66
Socio Economic Status		
Poor	93	93
Middle	7	7
High	Nil	Nil

Table II: Serum Electrolyte Profile of Children with Severe Acute Malnutrition

Serum Electrolytes	Reference Range	Count (n=100)	Percentage (%)
Potassium			
Normal	3.5-5.8 mmol/L	65	65
Hypokalemia	<3.5 mmol/L	23	23
Hyperkalemia	>5.8 mmol/L	12	12
Sodium			
Normal	136-146 mmol/L	57	57
hyponatremia	<136 mmol/L	28	28
Hypernatremia	>146 mmol/L	15	15
ASU			
Magnesium			
Normal	1.5-2.5 mg/dL	73	73
Hypomagnesaemia	<1.5 mg/dL	16	16
Calcium			
Normal	8.1-10.4 mg/dL	69	69
Hypocalcaemia	<8.1 mg/dL	28	28
Hypercalcaemia	>10.4 mg/dL	3	3

Table III: Mean Serum Electrolyte Profile of Children with Severe Acute Malnutrition

Serum electrolyte	Mean ±SD
Potassium	3.06 ± 1.75 mmol/L
Sodium	138.96 ± 8.6 mmol/L
Calcium	8.51 ± 1.58 mg/dL
Magnesium	2.23 ± 2.38 mg/dL

acute malnutrition, hypokalemia and hyponatremia were significant risk factor for acute diarrhea. Serum electrolyte balance along with diarrhea may results in increased mortality and morbidity in SAM children.

In current study, 86 (86%) children were of age 25-59 months. This study included 60% males and 40% females. Current results were comparable with the previous study conducted in India [8]. It may also indicate that despite gender discrimination, male children were at more risk of severe acute malnutrition than female child or perhaps more male children were admitted to hospitals for treatment than female child.

There were 66% cases presented with diarrhea and 34% cases without diarrhea which is comparable with a study conducted in Zambia (64% cases presented with diarrhea).[9] According to previous studies, diarrhea is directly linked to severe acute malnutrition and have a major impact on serum electrolyte balance as well.[10] These findings were also confirmed by the current study. Chronic and persistent diarrhea leads to severe acute malnutrition and SAM children were more prone to diarrhea due to low immunity and prolonged infections.[11]

In this study almost one third of cases had hyponatremia and these results were supported by another study conducted by Zulqarnain et al. which reported hyponatremia in 31.1% cases and 22.6% cases were reported by Bilal at al.[5,12] Our study included serum sodium level less than 136mmol/L as standard hyponatremia but Negussie at al. included serum sodium level less than 130mmol/L as hyponatremia.[13]

There were 23% cases of hypokalemia in current study, but previous studies included 55% and 13.7% cases of hypokalemia.[5,12] In current study, 12% and 15% cases were hyperkalemia and hypernatremia respectively. Current results included higher cases of hyperkalemia and hypernatremia as compared to previous studies.[12,14] The cases of hypocalcemia in current study were much higher than the previous studies.[14] This also indicated that the samples enrolled in our study were at much higher risk for complications regarding hypocalcemia.[15]

This research, however, is subject to limitations, the primary limitation was short time duration of six months, due to which random sampling technique was used. All the patients registered at the hospital during those six months, fulfilling the inclusion criteria were recruited. A study done for longer

period of time may include more samples and provide more concrete results to strengthen the findings of this study. According to the findings of this study, in severe acute malnutrition, hypokalemia and hyponatremia were significant risk factor for acute diarrhea.

Conclusion

Electrolyte imbalance is common in children with severe acute malnutrition with or without diarrhea. Determination of electrolyte profile of children with severe acute malnutrition admitted at stabilization centers in Pakistan should be ensured to reduce the mortality and morbidity.

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