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Original Research Article

Study of serum electrolytes with different clinical co-morbidities in complicated severe acute malnutrition children aged 6 months to 5 years

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ABSTRACT

Background: Severe acute malnutrition (SAM) is one of the most common health problem. SAM children are more prone to severe infections that culminates into different co-morbid conditions and consequentially leads to electrolyte derangements. Hence this study aims to find out the incidence of dyselectrolytemia (Na^+ and K^+) in malnourished children with different clinical co-morbid conditions.
Methods: It was a hospital based prospective, case-control study conducted on 100 children of complicated as study group and 50 children of uncomplicated SAM as control group, over a period of six months in year 2016. The children included as per WHO reference criteria of SAM in 6 months to 5-years age group. All the enrolled children were assessed with detailed clinical examination according to different co-morbidities, including anthropometry and routine investigations along with serum electrolytes (Na^+ and K^+) and chest x-ray.
Results: In our study, out of 100 complicated SAM children, dyselectrolytemia was present in 94.0% children. The SAM children with most co-morbidities had subnormal sodium ranging from 128-135 mEq/L while potassium was normal ranging from 3.68-4.34 mEq/L at the time of admission. We observed that mean sodium level was 131.82±6.66 mEq/L while mean potassium level was 4.17±1.03 mEq/L in complicated SAM children. In control group children mean sodium level was 135.90±4.26 mEq/L while mean potassium level was 4.14±1.11 mEq/L.
Conclusions: To conclude that dyselectrolytemia is high in complicated SAM and it is mainly sodium disturbances in the form of hyponatremia in different co-morbid conditions. Hence, we recommend that due care is to be given for management of dyselectrolytemia in complicated SAM children.

Keywords: Co-morbidities, Dyselectrolytemia, Potassium, Severe acute malnutrition, Sodium

INTRODUCTION

Severe acute malnutrition (SAM) is one of the most common health problem, involving hundreds of millions of children in the world.[1] According to National Family Health Survey-4, in India 7.5% of children below 60 months of age suffer from SAM and this has increased from the previous value of 6.4% children in NFHS-3.[2] Programmatically, it is helpful to categories children with SAM into complicated and uncomplicated. However, in children with severe acute malnutrition, addressing the problem through facility based approach alone is unfeasible.

Diarrhea and pneumonia accounts for approximately half the under-five deaths in India and malnutrition is believed to contribute to 61% of diarrheal deaths and 53% pneumonia deaths.[3]

Malnutrition increases the risk and worsens the severity of infections[4]. SAM children are more prone to severe infections that culminates into different co-morbid conditions and consequentially leads to electrolyte derangement due to reductive adaptation Na^+, K^+, ATPase systems of the body begin to 'shut down'.[5] Therefore, an even greater electrolyte derangement may occur when these co-morbid conditions are superimposed on SAM.

Hence this study aims to find out the incidence of dyselectrolytemia (Na^+ and K^+) in malnourished children with different clinical conditions. This would help to avoid life threatening situation by early recognition and proper therapy for electrolyte changes in SAM children.

METHODS

This was a hospital based prospective and case-control study conducted on 100 complicated SAM children aged 6-59 months and 50 children of uncomplicated SAM as control group, over a period of 6 months in 2016, admitted in tertiary care hospital attached to medical college. The study was approved by the ethical committee of the institute. A written informed consent was taken from parents of all malnourished children who fulfilled the inclusion criteria as per WHO reference of SAM in children of 6 months to 5 years.

Weight for height/length ≤3SD.

- Mid upper arm circumference (MUAC) of <11.5 cm.
- Bipedal nutritional edema.

Exclusion criteria

- Aged below 6 months and above 5 years
- Refusal for consent.

Admission criteria for complicated SAM

SAM children with any of the following complications

- Anorexia (Loss of appetite)
- Fever (39 ^{0}C) or Hypothermia (<35 ^{0}C)
- Persistent vomiting
- Severe dehydration based on history and clinical examination
- Not alert, very weak, apathetic, unconscious, convulsions
- Hypoglycemia
- Severe Anemia (severe palmar pallor)
- Severe pneumonia
- Extensive superficial infection requiring IM medications
- Any other general sign that a clinician thinks requires admission for further assessment or care

All the enrolled children underwent a detailed clinical examination, including anthropometry (weight, length/height, mid upper arm circumference, body mass index (BMI) and body surface area (BSA). The Serum electrolyte (Na^+ and K^+) levels were done by SnapPak that is automated electrolyte Analyzer and routine investigations (CBC, urea and creatinine, total serum protein, serum albumin SGOT, SGPT, blood sugar, HIV) were also done in all patients.

Statistical analysis

Results are expressed as mean ± standard deviation for continuous variables and as number (%) for categorical data. Since all data were normally distributed, the parametric tests were used for statistical analysis. Differences between electrolyte profile of complicated SAM children were determined by Student's t-test (independent group t-test). Pearson's correlation analysis was used to determine correlations between different variables. For all tests, the difference was considered significant if the probability (P) was <0.05. Statistical analysis was done by using SSSP version 20.

RESULTS

Out of 100 complicated SAM children, majority of population 76 % were in the age group of 6 months to 2 years. Mean age of complicated SAM was 16.45±10.40 months & consisted of 53.0% of males and 47.0% were of females and their sex ratio, M: F was 1.12. As per various criteria of SAM, majority of them 73.0% children were in SAM as per WFH/L criteria, 52.0% children fulfilled MUAC criteria and 14.0% of children were oedematous.

Basic mean Anthropometric variables in complicated and uncomplicated SAM patients were as shown in Table 1.

Table 1: Basic anthropometric variables in SAM patients.

Values	Complicated SAM		Uncomplicated SAM	
	Mean	SD	Mean	SD
Weight (kg)	5.77	1.24	6.53	1.54
Height/Length (cm)	69.55	6.88	71.77	8.71
MUAC (cm)	10.76	1.24	11.32	1.0
BMI (kg/m^2)	11.89	1.61	12.82	3.5

In complicated SAM, 40.0% children presented with complaints pertaining to diarrhoea and vomiting & 36.0% children were admitted due to acute respiratory tract infections while 11% children presented with malaria. Septicaemia, skin disease, meningitis, CHD with CHF, NTS and seizure disorder were present in frequency as shown in Table 2.

Table 2: Co-morbidities at the time of admission.

Co-morbid Conditions	No. of Cases	%
Diarrhoea/ Vomiting	40	40.00
Pneumonia	36	36.00
Malaria	11	11.00
Septicemia	6	6.00
Skin Disease	5	5.00
Meningitis	5	5.00
CHD with CHF	4	4.00
Nutritional Tremor Syndrome (NTS)	3	3.00
Seizure Disorder	1	1.00

In present study, out of 100 complicated SAM, there were 94.0% children had dyselectrolytemia. The SAM children with most co-morbidities had subnormal sodium ranging from 128-135 mEq/L while potassium was normal ranging from 3.68-4.34 mEq/L in all co-morbid conditions at the time of admission. We observed that mean sodium level was 131.82±6.66 mEq/L while mean potassium level was 4.17±1.03 mEq/L in complicated SAM children as shown in Table 3.

Table 3: Serum electrolyte profile (Na^+ and K^+) with co-morbidities at the time of admission.

Co-morbid Conditions	Mean Na^+ (mEq/L)	Mean K^+ (mEq/L)
Edematous SAM (Kwashiorkor)	128±7.84	4.02±1.06
Non-Edematous SAM (Marasmus)	132.41±6.37	4.21±1.03
Diarrhoea/ Vomiting	131.12±8.10	4.15±1.12
Pneumonia	134.24±5.33	4.34±1.07
Septicemia	129±2.83	4.24±0.14
Seizure Disorder	134.30	4.40
Malaria	131.82±4.98	3.97±0.86
CNS Infection	133±6.38	3.68±0.87
Complicated SAM (Mean)	131.82±6.66	4.17±1.03
Uncomplicated SAM (Mean)	135.90±4.26	4.14±1.11
P value	<0.001	>0.05

DISCUSSION

In present study, we observed that the incidence of dyselectrolytemia was very high which is mainly comprises of sodium disturbances while potassium was normal in all co-morbid conditions. Majority of children had hyponatremia in all different co-morbidities except few children of diarrohea had mild hypernatremia on admission. These hyponatremic children had co-morbid conditions as diarrhea/vomiting and pneumonia.

This hyponatremia can be explained in Malnourished children is due to either loss of more sodium in their stools during diarrhoea or development of SIADH from respiratory/CNS infections causing hyponatremia. Oedematous malnourished children had dilutional hyponatremia.

These findings are in similar to study by Gangaraj et al, who observed that there was a significant hyponatremia in malnourished children who had diarrhoea or vomiting.[6] Zogg et al, conducted a study and observed that older age, presence of diarrhea, and breathing difficulty in under-five children with SAM is independent predictors of hyponatremia.[7] Akhter et al, among a 100 protein energy malnourished children, 64±1.02% patients (Group-A) were edematous with 39±0.93% kwashiorkor and 25±0.78% marasmic kwashiorkor whereas 36± 0.86% (Group-B) was marasmic with 39±0.77% diarrhea.[8] The patients have been suffering from acute respiratory infection 25±0.35%, septicemia 29±0.66%, tuberculosis 7±0.36% and other secondary infections. Analysis of serum electrolytes revealed that hypokalemia was seen in 46±0.84% patients of Group-A and 20±1.01% of group B. Hypernatremia (Group-A) was seen in 14±0.64% patients, low serum sodium was in 52±0.55% while 32±0.73% of them had diarrhea. The results demonstrate that protein energy malnutrition significantly affecting electrolytes of diarrheal children.

To conclude that dyselectrolytemia is high in complicated SAM and mainly sodium disturbances in form of hyponatremia is common in different co-morbid conditions. Hence, we recommend that due care is to be given for management of dyselectrolytemia in complicated SAM children.

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