e-ISSN: 0975-1556, p-ISSN:2820-2643

Available online on www.ijpcr.com

International Journal of Pharmaceutical and Clinical Research 2024; 16(1); 930-934

Original Research Article

Changes in Biochemical Profiles of Children with Severe Acute Malnutrition on Admission and After Nutritional Rehabilitation

Amarjeet Patel[1*], Randhir Kumar Mishra[2], K. N. Mishra[3]

[1]Senior Resident, Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, Bihar
[2]Senior Resident, Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, Bihar
[3]Professor, Department of Pediatrics, Darbhanga Medical College & Hospital, Laheriasarai, Bihar

Received: 25-10-2023 / Revised: 23-11-2023 / Accepted: 26-12-2023
Corresponding Author: Dr. Randhir Kumar Mishra
Conflict of interest: Nil

Abstract:

Background: According to the National Family Health Survey-3, the prevalence of severe acute malnutrition in children under five is estimated to be 2.6% worldwide and 6.4% in India. The goal of the current study was to compare the biochemical profiles of children admitted with severe acute malnutrition (SAM) before and after nutritional rehabilitation.

Methods: A hospital based observational study was undertaken at Department of Pediatrics, Darbhanga Medical College and Hospital, Laheriasarai, Bihar from June 2022 to May 2023 with 55 consecutive cases of SAM. Thirteen biochemical parameters were analyzed using the Vitros System 5600.

Results: Serum potassium, sodium, and chloride mean values were 4.22±0.80 mEq/L, 101.12±16.36 mEq/L, and 134.59±19.37 mEq/L at admission; these values decreased to 136.66±19.95 mEq/L, 4.42±0.68 mEq/L, and 103.97±4.83 mEq/L following rehabilitation. In contrast, the values for magnesium, calcium, and phosphorus were 2.11±0.38 mg/dL, 8.70±1.00 mg/dL, and 4.33±1.23 mg/dL at admission, and 2.10±0.29 mg/dL, 9.45±0.65 mg/dL, and 4.76±0.84 mg/dL following rehabilitation, respectively. Serum total protein, albumin, globulin, and A: G had mean values of 6.53±1.44 g/dL, 3.30±0.88 g/dL, 3.23±0.87 g/dL, and 1.06±0.33 before admission; those values changed to 6.84±0.98 g/dL, 3.86±0.57 g/dL, 2.98±0.69 g/dL, and 1.34±0.28 correspondingly, during rehabilitation. The average levels of creatinine and urea were determined to be 26.25±19.30 mg/dL and 0.34±0.24 mg/dL at admission, respectively. Following rehabilitation, the levels were found to be 23.91±11.76 mg/dL and 0.31±0.15 mg/dL, respectively. Upon admission, the patient's random blood sugar (RBS) was 85.20±17.88 mg/dL; during rehabilitation, it was 94.18±14.82 mg/dL. After rehabilitation, the mean value of calcium, phosphorous, albumin, A: G, and RBS were dramatically raised.

Conclusion: Following nutritional rehabilitation, the biochemical abnormalities in a patient with severe acute malnutrition (SAM) improve and are linked to severe morbidity.

Keywords: Biochemical Profile, Nutritional Rehabilitation, Severe Acute Malnutrition, Tea-Garden Community.

Introduction

Up to 33% of children in underdeveloped nations have been found to suffer from some type of malnutrition. Severe Acute Malnutrition (SAM) is characterised by a mid-upper-arm circumference of less than 110 mm in children aged 1 to 5 years, bilateral pitting oedema of nutritional origin, a weight-for-height measurement of 70% or less below the median, or three standard deviations or more below the mean National Centre for Health Statistics reference values [1]. As per the National Family Health Survey-3[2], the prevalence of SAM among children under 5 years old is estimated to be 2.6% worldwide and 6.4% in India. In fewer than five children, the percentage of underweight children is found to be 25–34%; in states like Madhya Pradesh and Uttar Pradesh, it exceeds 40%. In children suffering from severe acute malnutrition, the risk of death is up by nine times [3]. When it comes to severe malnutrition, the median case fatality rate is roughly 23.5%, and for oedematous malnutrition, it reaches 50% [4].

In India, Nutritional Rehabilitation Centers (NRC) has been established to provide rehabilitative care for children with SAM in accordance with the WHO Protocol. Here, the mothers received counseling in addition to the inpatient management of their youngsters by qualified professionals. When they satisfy the discharge criteria, they are released from hospital and are recommended to have frequent field follow-ups [5].

Materials and Methods

This hospital based observational study was conducted at Department of Pediatrics, Darbhanga Medical College and Hospital, Bihar from June 2022 to May 2023. The department has admitted 55 cases in a row. All cases from 6 to 60 months who fulfill the criteria for SAM according to according to WHO, that is, weight for height below minus 3SD on the WHO standard growth chart; and/or presence of bipedal edema; and/or mid upper arm circumference (MUAC) below 11.5 cm were included in the study. Patients with known cases of cancer, chronic kidney disease, immunodeficiency syndrome, metabolic diseases, and refusal to consent to the study were all excluded from the research, as were those taking any medications that might cause a notable alteration in their metabolic profile.

Parents gave their informed agreement, and children who met the requirements for Enrollment were included. A thorough medical history, physical examination, and anthropometric assessment were conducted, and data was gathered using pre-made proforma. Venipuncture was used to acquire blood, which was then collected in a clot activator vial both throughout hospital stay and during nutritional rehabilitation. The second sample was taken upon discharge or during follow-up, ideally at least two weeks after nutritional rehabilitation began. Following two weeks is standard procedure, following departmental guidelines. Following the child's initial stabilization, the F75 diet and additional supplements were started, and as the youngster tolerated the F75 diet, the F100 diet was gradually introduced. Specific anthropometric criteria and overall clinical improvement, as defined by the WHO protocol, were used to evaluate the success of nutritional rehabilitation (no edema for at least two weeks, plus weight-for-height achieves −2SD or higher on the WHO Growth Standard or MUAC more than 12.5 cm).

At the Department of Biochemistry, Bio-Chemical Laboratory, DMCH, the biochemical profiles were completed using all conventional procedures. Thirteen parameters in total were examined. For analysis, the Vitros system 5600 was employed.

The data collected were tabulated in Microsoft Excel Worksheet and computer-based analysis was performed using the statistical product and service solutions (SPSS) 20.0 software (SPSS, Chicago, Illinois, USA) and Microsoft Excel 2010. In order to assess the categorical variables, which were represented as proportions and percentages, Fischer's exact test and the Chi-square test were used (where the cell counts were <5 or 0). The statistical significance threshold for all analyses was set at 5% ($p<0.05$).

Results

Of the 55 cases examined, 5 (or 9% of the total) expired; 24 of the cases involved men and 31 involved women. The study did not cover the instances that were not followed up on. At presentation, the average age was 32.02±15.84 months. The greatest percentage of cases (58.18%) fell into the Upper-Lower class of the Modified Kuppuswamy Classification. The cases were also categorized as malnourished according to the IAP, with the majority of cases falling into Grade II (49.09%) and Grade III (43.64%) categories. The mean weight, height, head circumference, and MUAC for both genders in the 6–60 month age group were 8.23±2.09 kg, 83.23±12.35 cm, and 10.78±0.93 cm, respectively. The average length of stay in the hospital was 12.49±5.64 days.

Fever (72.73%) was the most common presenting symptom, followed by lethergy (40.00%); edema (38.18%) and fever (34.54%) were the most prevalent findings on the clinical examination. Based on the distribution of comorbidities by age group upon admission, we discovered that severe pneumonia (20.00%) was the most common comorbidity, followed by tuberculosis (29.09%).

When compared to other electrolytes (potassium and chloride), the mean value of serum sodium (134.59±19.37 mEq/L) was found to be subnormal upon admission. There was no discernible difference between the mean values (Table 1) at admission and following nutritional rehabilitation. Table 1 shows the mean values of serum total protein, albumin, globulin, and A: G. Upon admission, the mean serum albumin value was found to be lower than normal (3.30±0.88 mg/dL).

Following nutritional rehabilitation, there was a significant change ($p=0.000$) in the mean value of serum albumin, which was raised but still below normal. Furthermore, the A: G ratio difference on admission and after rehabilitation was substantial ($p=0.000$). It was discovered that the mean serum magnesium, calcium, and phosphorus readings (Table 1) fell within the normal range. The mean serum calcium ($p=0.000$) and phosphorus ($p=0.038$) values were found to be significantly elevated but still within the normal range following nutritional rehabilitation. Serum urea was discovered to be elevated, although the mean serum creatinine value (Table 1) was found to be within the normal range both upon admission and following nutritional rehabilitation.

Following nutritional rehabilitation, there was a drop in the mean serum urea value, but it was still close to the upper limit. Random blood sugar (RBS) mean levels were determined to be within the normal range both at admission and during nutritional rehabilitation; the change in mean was statistically significant ($p=0.006$).

Table 1: Comparison of mean values of parameters on admissionand after nutritional rehabilitation

Parameters	On admission		After nutritional rehabilitation		p-value
	Mean	SD	Mean	SD	
Na (mEq/L)	134.59	19.37	136.66	19.95	0.087
K (mEq/L)	4.22	0.80	4.42	0.68	0.172
Cl (mEq/L)	101.12	16.36	103.97	4.83	0.052
Total Protein (g/dL)	6.53	1.44	6.84	0.98	0.149
Albumin (g/dL)	3.30	0.88	3.86	0.57	0.000#
Globulin (g/dL)	3.23	0.87	2.98	0.69	0.081
A: G	1.06	0.33	1.34	0.28	0.000#
Mg (mg/dL)	2.11	0.38	2.10	0.29	0.832
Ca (mg/dL)	8.70	1.00	9.45	0.65	0.000#
p (mg/dL)	4.33	1.23	4.76	0.84	0.038#
Urea (mg/dL)	26.25	19.30	23.91	11.76	0.461
Creatinine (mg/dL)	0.34	0.24	0.31	0.15	0.591
RBS (mg/dL)	85.20	17.88	94.18	14.82	0.006#

In biochemical profiles Table 2, it was found that hypoalbuminemia (49.09%) and hyponatremia (49.09%) were the most common derangements, accounting for nearly half of the cases.

Among the cases upon admission, hypocalcemia (23.64%) and hypermagnesemia (21.82%) were also quite common. Following nutritional rehabilitation, the greatest improvement was seen in the decline in hypocalcemia (3.64%), which was followed by hypoalbuminemia (18.18%).

However, there was a rise in cases of hypermagnesemia, which may have resulted from the current study's lower cut-off point for the condition.

Table 2: Comparison of mean values of parameters on admission and after nutritional rehabilitation

Parameters	On admission		After nutritional rehabilitation	
	No.	Percentage	No.	Percentage
Na (mEq/L)				
• Hyponatremia <135	27	49.09%	21	38.18%
• Hypernatremia <145	3	5.45%	5	9.09%
K (mEq/L)				
• Hypokalemia <3.5	11	20.00%	4	7.27%
• Hyperkalemia >5.5	4	7.27%	4	7.27%
Ca (mg/dl)				
• Hypocalcemia <8	13	23.64%	2	3.64%
• Hypercalcemia >11	1	1.82%	1	1.82%
Mg (mg/dl)				
• Hypomagnesemia <1.5	2	3.64%	1	1.82%
• Hypermagnesemia >2.3	12	21.82%	15	27.27%
P (mg/dl)				
• Hypophosphatemia <3.7	5	9.09%	0	0.0
• Hyperphosphatemia <4 yr : >6.5 yr; >4 yr :<5.6	1	1.82%	0	0.0
Albumin (mg/dl)				
• Hypoalbuminemia <3.5	27	19.09%	10	18.18%
RBS (mg/dl)				
• hypoglycemia	1	1.82%	0	0.0

With the exception of hypophosphatemia (3.52±1.63 mg/dL) in the vomiting group, subnormal sodium in the loose stool and abdominal distension groups (Tables 3-5), and a significant (p=0.039) difference in mean albumin between the edematous and non-edematous groups (Table 6), all mean values for the parameters related to the clinical manifestation under investigation were found to be within the normal range.

Table 3: Mean values of Na, K, and Cl according to presenting complaints

Parameters	Number of patients	Na (mEqq/L)		K (mEq/L)		Cl (mEQ/L)	
		Mean	SD	Mean	SD	Mean	SD
Dehydration	4	139.61	4.27	4.92	0.47	102.40	8.27
Vomiting	7	135.44	9.47	4.12	1.10	101.95	7.83
Loose stool	5	133.47	6.20	4.07	0.75	101.64	9.68
Convulsion	8	136.22	48.64	4.44	0.84	104.30	37.77
Lethargy	22	135.81	6.15	4.18	0.79	101.31	8.51
Abdominal distension	11	134.96	4.60	4.20	0.79	98.81	6.60

Table 4: Mean values of Mg, Ca, and P according to presenting complaints

Parameters	Number of patients	Mg (mg/dL)		Ca (mg/dL)		P (mg/dL)	
		Mean	SD	Mean	SD	Mean	SD
Lethargy	22	2.08	0.31	8.59	1.16	4.13	1.56
Convulsion	8	2.23	0.52	8.72	0.99	4.40	0.86
Abdominal distension	11	2.13	0.18	8.40	0.83	3.86	1.46
Vomiting	7	1.91	0.47	8.36	1.23	3.52	1.63

Table 5: Mean of RBS according to presenting complaints

Parameters	Number of patients	Mg (mg/dL)	
		Mean	SD
Lethargy	22	79.77	16.27
Convulsion	8	85.50	14.30

Table 6: Comparison of mean of albumin in edematous and non-edematous group

Parameters	Edematous		Non-edematous		p-value
	Mean	SD	Mean	SD	
Albumin (mg/dL)	3.03	0.83	3.48	0.91	0.039

Discussion

The reason for the subnormal blood sodium in a patient with SAM might be attributed to dilutional in cases of edematous SAM or diarrheal loss or SIADH caused by CNS illnesses [12]. The subnormal character of sodium in different studies on admission. On day 8, Owais and Sridhar displayed improving Na, which in the current study after rehabilitation returned to normal. However, the percentage of each dyselectrolytemia is reduced in present study compared to Owais and Sridhar.

Following nutritional rehabilitation, a SAM patient's serum levels of calcium and phosphorus significantly increase. Serum magnesium levels stay consistent. Each of these components is crucial to catching up growth. Refeeding syndrome has also been connected to phosphorus. It is concerning to what extent these components are adequately supplemented with locally sourced foods. Furthermore, Vitamin D insufficiency persists in pandemic proportion in India that can lead to low level of Ca and P.In a research conducted at the same facility by Gogoi[17], vitamin D deficiency was shown to be as common as 31.43% among SAM patients, with a mean value of 34.31±20.78 ng/dL.

The current study Ca, P, and Mg levels are significantly greater than those of Bushra et al. [18]. In addition, the current study's percentage of hypophosphatemia, hypomagnesemia, and hypocalcemia was significantly lower than that of Chanchal et al. and Khan et al. The disparity in the cutoff limit established for various studies may also have an impact on the outcome. Borah [11] found a correlation between rising malnutrition grades and a declining albumin level. Serum albumin mean levels for the edematous and non-edematous groups at admission differed significantly (p=0.039). While there is compelling evidence linking low blood albumin levels to Kwashiorkor, current research suggests that these levels may not be necessary for the development of edema [2].

Lower levels of creatinine have been linked to wasting-related reductions in muscle mass (Samad et al.)[16]. After nutritional rehabilitation, serum urea levels fall, but they remain elevated, which can be attributed to the continuous catabolic condition.

While hypoglycemia was found to be similar to the current study in Mbethe and Mda (2%) and Gangaraj et al. (3.9%), it was significantly greater in Ashok et al. (25.3%).

The study provides a thorough description of nutritional rehabilitation in terms of biochemical alterations and how they relate to clinical and demographic changes. Large-scale replication of the study could increase its importance. The primary restriction was the sample's limited size. The study missed the instances at the community who did not access health-care facilities. Additionally, the study only considers a small

portion of the nation's kid nutrition. A more physiological sign of the metabolic condition would have been ionized calcium. Understanding the pathophysiology of SAM might have been improved with samples collected during the transition phase and during long-term follow-up.

Conclusion

In a patient with SAM, albumin and sodium levels are abnormal. Following the treatment, there is a noticeable increase in calcium and phosphorus. Following nutritional rehabilitation, serum albumin levels significantly rise. Elevated urea levels persist following rehabilitation, however they do not go down. Nearly half of the cases have both hypoalbuminemia and hyponatremia. Additionally common is hypocalcemia. Twelve days is the minimal amount of time needed for rehabilitation.

References

1. Operational Guidelines on Facility Based Management of Children with Severe Acute Malnutrition, Ministry of Health and Family Welfare, Government of India, 2011. Available from: http://www.nihf.org/NCHRC-Publications/ Operational Guidelines.
2. International Institute for Population Sciences (IIPS) and Macro International. National Family Health Survey (NFHS-3), 2005-2006. Mumbai: IIPS; 2007.
3. United Nations Children's Fund (UNICEF). Tracking progress on child and maternal nutrition. A survival and development priority. New York: United Nations Children's Fund (UNICEF); 2009.
4. Ashworth A, Khanum S, Jackson A, Schofield C. Guidelines for the inpatient treatment of severely malnourished children. Geneva: World Health Organisation; 2003.
5. World Health Organization (WHO), United Nations Children's Fund (UNICEF). WHO Child Growth Standards and the identification of severe acute malnutrition in infants and children. Geneva, Switzerland: World Health Organization and the United Nations Children's Fund; 2009.
6. International Institute for Population Sciences (IIPS) and ICF, 2020. National Family Health Survey (NFHS), India, 2019-20. Assam, Mumbai: IIPS. Available from: https://www.rchiips.org/nfhs [Last accessed on 2022 Sep 08].
7. Elizabeth KE. Triple burden of malutrition. In: Elizabeth KE, editor. Nutrition and Child Development. 5th ed. Hyderabad: Paras Medical Publisher; 2015;185-284.
8. WHO. Severe Acute Malnutrition. Available from: https://www.apps.who. int/nutrition/ topics/severe_malnutrition/en/index.html [Last accessed on 2020 Nov 04].
9. User Defined Assay (UDA) Guide VITROS 5600 Intigrated System Ortho Clinical Diagnostics. Available from: https://www. ortho-clinicaldiagnostics. com [Last accessed on 2020 Mar 22].
10. Greenbaum LA. Fluid and electrolyte disorders. In: Kliegman RM, Blum NJ, Shah SS, Geme JW 3rd, Tasker RC, Wilson KM, editors. Nelson Textbook of Pediatrics. 21st ed. New York: Elsevier; 2020;392-407.
11. Afzal K. Fluid and electrolyte disturbances. In: Paul VK, Bagga A, editors. Ghai Essential Paediatrics. 9th ed. New Delhi: CBS Publishers & Distributors; 2019; 76-80.
12. Bedi N, Dewan P. Laboratory values and drug doses. In: Gupta P, Menon PS, Ramji S, Lodha R, editors. PG Textbook of Paediatrics. 2nd ed. New Delhi: Jaypee Brothers Medical Publishers Ltd.; 2018; 3255-7.
13. Albumin/Globulin Ratio: High and Low Ratios + Normal Range. Available from: https:// www.labs.selfdecode.com [Last accessed on 2022 Dec 22].
14. One Touch Select Simple Owner's Guide India English. Available from: https://www. onetouch.in [Last accessed on 2021 Oct 28].
15. David R. Diabetes mellitus. In: Kligman RM, Blum NJ, Shah SS, Geme JW 3rd, Tasker RC, Wilson KM, editors. Nelson Textbook of Paediatrics. 21st ed. New York: Elsevier; 2020; 3019.
16. Borah P. Assessment of thyroid hormones in protein energy malnutrition among children of 1 to 5 year of age-a hospital-based study. Dibrugarh: Srimanta Sankardev University of Health Sciences; 2014; 81-2.
17. Meena SK, Suman RL, Jain R, Meena P. Study of serum electrolytes with different clinical comorbidities in complicated severe acute malnutrition children aged 6 months to 5 years. Int J Contemp Pediatr 2017; 4:1426-9.