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Original Article

Study of biochemical and nutritional indicators in severe acute malnutrition: A prospective observational study

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ABSTRACT

Background: Malnutrition in children is widely prevalent in developing countries including India. More than 33% of the deaths in 0-5 years are associated with malnutrition. Children with severe acute malnutrition (SAM) are in danger of death from hypoglycemia, hypothermia, fluid overload, electrolyte mismanagement, and undetected infections. Hence, biochemical and nutritional indicators in these children are important for management. **Objectives:** To study the biochemical and nutritional indicators in children with SAM. **Methods:** This hospital based prospective study was conducted on children aged 6-59 months admitted at Nutrition Rehabilitation Center attached to a tertiary care teaching institution. 100 consecutive SAM children admitted during 2013-2015 were studied. Children were tested for biochemical and nutritional status like complete blood picture with peripheral smear, liver function tests, renal function tests, serum electrolytes, calcium, phosphorus, and alkaline phosphatase. **Results:** A total of 100 cases were included, of these 57 were male and female were 43. Mean age of presentation was 18.45±2.37 months. A lack of exclusive breastfeeding was seen in 67% of these children and in 78% children complimentary feeds were initiated either early or later than 6 months. Hypoglycemia was seen in 15% cases, hypokalemia in 22%, and hypocalcemia in 35% of cases. Hyponatremia was seen in 14% and hypernatremia in 19% of the children. The most common type of anemia was microcytic hypochromic type (55%). **Conclusion:** The observations in this study confirm a significant association between SAM and faulty feeding and early introduction of complementary feeds. It was observed that these children have significant alterations in nutritional indicators at admission.

Key words: *Biochemical markers, Severe acute malnutrition, Nutritional indicators*

Malnutrition is a general term and it most often refers to undernutrition resulting from inadequate consumption, poor absorption or excessive loss of nutrients but the term also encompasses overnutrition, resulting from excessive intake of specific nutrients. Malnutrition in children is widely prevalent in developing countries including India. More than 33% of deaths in 0-5 years are associated with malnutrition [1,2]. Severe acute malnutrition (SAM) is defined by very low weight-for-height/length (z score below −3SD of the median WHO child growth standards), or a mid-upper arm circumference <115 mm, or by the presence of nutritional edema. SAM is both medical and social disorder. The medical problem is due to social problems at home. Lack of exclusive breastfeeding, late introduction of complementary feeds, feeding diluted feeds containing less amount of nutrients, repeated enteric and repeated respiratory tract infections, ignorance, and poverty are some of the factors responsible for SAM [1].

Children with SAM are in danger of death from hypoglycemia, hypothermia, fluid overload, electrolyte mismanagement, and undetected infections. They cannot be treated like other children. Their feeds, fluids, and micronutrients must be carefully controlled to avoid complications during management [2]. Hence, biochemical and nutritional indicators in these children are important for management. They guide us to prevent mishappenings in the management of SAM children in causality and especially in nutrition rehabilitation centers (NRC) and help in giving proper correction of micronutrients [3,4]. Our study tried to find out the nutritional indicators at admission and also variations in the biochemical markers in these children at admission. This would help in further holistic management of these children.

METHODS

This hospital based, prospective observational study, was conducted in Tertiary Care Institution of South India after obtaining approval from the Institutional Ethics Committee. Children aged 6-59 months admitted at NRC of Vanivilas Children hospital and Bowring and Lady Curzon Hospital attached to Bangalore Medical College and Research institute were enrolled. After obtaining informed consent from parents or legal guardians, 100 consecutive SAM children admitted during

2013-2015 were enrolled for the study. WHO growth charts were used to define SAM (i.e., weight for length <3SD from WHO standards or presence of visible severe wasting or bilateral pedal edema or mid-upper arm circumference of <11.5 cm). Children with any congenital anomalies or children with SAM secondary to known congenital, chromosomal, endocrine, or other systemic disorders like neurological or surgical problems were excluded from the study.

The biochemical and nutritional status of all the recruited children was assessed at the time of admission. Investigations included complete blood picture with peripheral smear, liver function tests, renal function tests, serum electrolytes, calcium, phosphorus and alkaline phosphatase, and detail feeding history was done at the time of admission.

Statistical Analysis

Data were analyzed using descriptive statistics, to compare the sensitivity of biochemical and nutrition profile. The data were collected from pretested questionnaires; collected data were analyzed using SAS-16.20 - 2013 version.

RESULTS

A total of 100 cases were included, of these 57 were male and female were 43. Criteria for diagnosis of SAM in these children are given in Table 1. The mean age of presentation of SAM children was 18.45±2.37 months. The most common age group of presentation was between 6 and 24 months. 30% of cases had more than 2 children in their family. Lack of exclusive breastfeeding was seen in 67% of these children and in 78% children complimentary feeds were initiated either early or later than 6 months. Furthermore, in 72% children faulty feeding practices were being practiced such as diluted milk, bottle feeding, etc. As shown in Table 2, hypoglycemia was seen in 15% cases, hypokalemia in 22%, and hypocalcemia in 35% of cases. Hyponatremia was seen in 14% and hypernatremia in 19% of the children. Anemia seen in 98% of cases and 16% had severe anemia with moderate anemia being most common (75%). The most common type in peripheral blood smear was microcytic hypochromic blood picture (55%) as shown in Table 3. Serum albumin was <2.5 g/dl (hypoalbuminemia) was seen in 7% cases while 51 and 42 children have serum albumin between 2.5-3.5 and 3.5-5 g/dl, respectively.

DISCUSSION

Child undernutrition is assessed by measuring height and weight and screening for clinical manifestations and biochemical markers. Indicators based on weight, height, and age are compared to international standards and are most commonly used to assess the nutritional status of a population. Stunting (inadequate length/height for age) captures early chronic exposure to undernutrition; wasting (inadequate weight for height) captures acute undernutrition; underweight (inadequate weight for age) is a composite indicator that includes elements of stunting and wasting.

To define nutritional status based on the anthropometric indices, cutoff values are used. Nutrition indicators are a tool to measure and quantify the severity of malnutrition and provide a summary of the nutritional status of all children in the measured group. It provides a method by which the nutritional status of a group can be compared easily over time or with other groups of interest [3].

Although malnutrition may arise at any stage in life, its occurrence in children is particularly noteworthy for its detrimental effect on growth and development. Severe chronic malnutrition generally occurs during infancy and early childhood. In countries at risk for malnutrition, early introduction of complementary feeds - which often starts before the 4th month - children receive little or no dairy food or other products of animal origin. A low-protein, low-energy diet coupled with frequent digestive and respiratory infections, favors the slow but progressive development of severe malnutrition [4]. Signs leading to the diagnosis of chronic malnutrition include low height and weight for age, indicating stunted growth, whilst the most common biochemical alterations are low serum hemoglobin and albumin levels on admission to hospital. Patients may also display hypoglycemia and iron deficiencies [5].

The mean age distribution in this study is 18.45±2.37 months. Faulty feeding is an important contributory factor in this age group [6]. In this study, only 34% of mothers had exclusively breastfed their children and 72% had faulty feeding habits mainly

Table 1: Criteria for SAM

Parameters	n (%)
Weight for height<3z	80 (80)
Pedal edema	11 (11)
Mid arm circumference	9 (9)

Table 2: Serum electrolytes levels

Electrolytes	n (%)
Serum sodium	
Hyponatremia	14 (14)
Hypernatremia	19 (19)
Serum potassium	
Hypokalemia (<2.5)	22 (68)
Hyperkalemia (>3.5)	22 (68)
Serum calcium	
<8	35 (35)
8-10	65 (65)
>10	10 (10)

Table 3: Peripheral smear (n=100)

Peripheral smear	Count (%)
Dimorphic anemia	5 (5.00)
Microcytic hypochromic anemia	55 (55.00)
Normocytic hypochromic anemia	1 (1.00)
Normocytic normochromic anemia	39 (39.00)

due to ignorance and also due to busy schedule of mothers in handling more than one child. A SAM child requires special care for the management and requires multidisciplinary approach such as social, medical, and educational. SAM children need to be managed holistically as their physiological state is altered from well-nourished children of same age and sex.

In our study, 15% cases had hypoglycemia, and 22% cases had hypokalemia while hypocalcemia was seen in 35%, hypoalbuminemia in 7% and hypernatremia in 19% cases. Tariq et al., in a similar study found hypoglycemia in 6.8%, hypokalemia in 9.5%, hypocalcemia in 10.12%, hypoalbuminemia in 20.2%, and hypernatremia in 8.2% cases, which was comparable to the findings of our study [7]. We had more cases of hypoglycemia as cases received to our hospital were very sick and referred late, and more cases of hypocalcemia due to the early weaning and faulty feeding.

Children with SAM are more prone to develop micronutrient deficiency like iron, folic acid, vitamin B12, and also protein malnutrition which manifest as varied presentation in peripheral blood picture. In this study, 55% of the children had microcytic hypochromic blood picture, 5% had dimorphic blood picture, and 1% had normocytic normochromic blood picture and 39% normocytic hypochromic blood picture. Thakur et al., in their study, found 27.7% cases with normocytic blood picture and 38.6% with microcytic hypochromic blood picture while 30.5% had megaloblastic anemia and 3.2% cases had dimorphic blood picture which was comparable to our study [8]. We had more cases of microcytic hypochromic anemia which may be due to the fact that patients admitted to our hospital were from very low social economic classes and illiterate and they lack knowledge about feeding practices.

Based on WHO criteria for the diagnosis of SAM, weight for height <3z score were found in 80% cases, and mid-upper arm circumference <11.5 cm in 9% cases, while 11% cases had pedal edema. Kumar et al. [9] had shown that in their study, 78.5% had weight for height <3z and 27% had pedal edema. **C**hand and Shah [10] in their study showed that mid-upper arm circumference <11.5 cm was of high sensitivity (92.1%) in diagnosing SAM. However, in our study, we had weight for height 80% as a more sensitive screening tool. There are certain limitations of our study that sample size was small and exact picture in community cannot be commented on being hospital based study.

CONCLUSION

The observations in this study confirm a significant association between severe acute and biochemical and nutritional indicators as well as feeding practices. At the time of admission, most of these children have anemia, hypocalcemia, hypokalemia, hypernatremia, hypoglycemia, and hypoalbuminemia.

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