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Original Research Article

Hematological profile of children with severe acute malnutrition: a tertiary care centre experience

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ABSTRACT

Background: Severe acute malnutrition (SAM) is associated with various pathophysiological changes in the body including hematological system. This study was done to understand the hematological profile of severely malnourished children.
Methods: This case control study was conducted in the Department of pediatrics, G.S.V.M. Medical College, Kanpur from January 2014 to December 2015. 200 children, aged 6 months- 5years admitted to our hospital with SAM were enrolled as cases. 200 children with normal nutritional status without haematological or infectious conditions attending routine clinic were selected as controls. The hematological parameters were analyzed using an automated blood Analyzer.
Results: 95% of the children with SAM had anemia, out of which 52% were severely anemic and 28% were moderately anemic. Mean value for hemoglobin was lower in test group (7.17±2.265gm/dl) as compared to control group (9.22±3.362gm/dl). Children with SAM had statistically significant lower mean values for red cell indices like RBC counts, MCV, MCH and MCHC compared to controls. The mean value of WBC in SAM children was 12.1±11.5×103, while it was 6.2± 7.8×103 in controls. The cases had higher mean value for neutrophils and lower mean value for lymphocytes.
Conclusions: Children with SAM had lower mean hemoglobin, hematocrit and red cell indices and higher mean value of total leukocyte and platelet counts. This study recommends that more frequent studies should be done to describe the trend of hematopoietic changes in children with SAM to enhance anticipatory care and outcome of the affected children.

Keywords: Anemia, Hematological profile, Severe acute malnutrition

INTRODUCTION

Protein Energy Malnutrition (PEM) is defined as a spectrum of diseases arising as a result of an absolute or relative deficiency of calories and/or protein in the diet.[1] In 2009, the World Health Organization (WHO) estimated that 20 million children under 5 years suffered from severe acute malnutrition (SAM) worldwide, which is associated to more than half of their deaths each year in developing countries.[2] SAM has been a real obstacle to the achievement of the fourth Millennium Development Goal (MDG).[3] Severe acute malnutrition is a major public health issue, which affects 7.5% of under-five children in

India according to NFHS-4survey.[4] Nearly 0.6 million deaths and 24.6 million DALYs (disability adjusted life years) are attributed to this condition.[5]

It results in the various pathophysiological changes in the body systems including significant changes in hematological parameters. Low red cell counts resulting in anemia has always been a constant feature of protein energy malnutrition and may be normochromic normocytic, microcytic hypochromic or macrocytic.[6,7] White cell changes demonstrates the synergistic relationship which SAM has with infections and thymic atrophy.[8]

In India, there is paucity of data on hematological profile of severely malnourished children. So, this study was undertaken in order to guide the appropriate management of hematological abnormalities of the children admitted at our nutritional rehabilitation centre to improve their prognosis.

METHODS

This case control study was conducted in the Department of pediatrics, Ganesh Shankar Vidyarthi Memorial Medical College, Kanpur over a period of two years From January 2014 to December 2015.

A total number of 200 children admitted at our hospital with a diagnosis of severe acute malnutrition based on the WHO criteria between age group 6 month to 5 years were enrolled as cases.[9] 200 children with normal nutritional status without haematological or infectious conditions attending routine clinic were selected as controls.

Children aged <6 months and >5 years, children with mild and moderate malnutrition, children with chronic illnesses and history suggesting ongoing haemolysis and haemoglobinopathies were excluded from the study.

A written and informed consent was obtained from the parents. A detailed and thorough history along with complete anthropometry and physical examination was done.

Under aseptic conditions, 3 ml of venous blood was collected into a sample bottle containing ethylene diamine tetra acetate (EDTA) and gently mixed to prevent clotting.

The sample was analyzed using an automated blood Analyzer model/Medonic. Peripheral blood smears were looked into and other laboratory tests were done to find out the type of anemia, as required. Severity of anemia was graded according to WHO criteria.[10]

Data analysis

The data was analyzed using Statistical Package for the Social Sciences (SPSS) for Windows Version 16.0 (SPSS Inc; Chicago, IL, USA).[11] and online Graph pad software.[12]

The Independent-Samples t- test was used to examine the association between different variables and strength of the relationship. P-value <0.05 was considered as statistically significant.

RESULTS

Out of 200 cases of severe acute malnutrition, 95% children had anemia, out of which, 8 (4%) cases had mild Anemia, 92 (46%) cases had moderate anemia and 90 (45%) cases had severe anemia (Table 1).

Table 1: Grading of severity of anemia in study population (n=200).

Type of anaemia	No. of cases	Percentage
No	10	5
Mild	8	4
Moderate	92	46
Severe	90	45

The mean hemoglobin values for subject and controls were 7.17±2.265 gm/dl and 9.22±3.362 gm/dl respectively while their mean hematocrit values were 21.27±6.63% and 27.40±8.98% and the difference was statistically significant.

Significant difference in the various RBC indices was observed between the cases and controls. Mean value of RBC count, PCV, MCV, MCH and MCHC of the test group were significantly lower as compared to the control group except the RDW, which was also less but not statistically significant (Table 2).

The mean value of WBC in SAM children was 12.1±11.5×103, while it was 6.2±7.8×103 in controls (p=0.001). In children with SAM, mean value for total leucocyte count along with neutrophil count was increased but lymphocyte count was decreased as compared to the control group.

The mean value of platelet count was 2.89±1.32×105/mm^3 and 3.02±1.02×105/mm3 in cases and controls respectively but the decrease in test group was not found to be statistically significant (Table 2).

DISCUSSION

The current study confirms that anemia is a constant feature of severe acute malnutrition, as reported by previous studies.[13]

In present study, 95% children with SAM were found to be anemic, out of which 52% were severely anemic and 28% were moderately anemic. This finding was similar to a study done by Thakur et al, where they reported 81.1%

severely malnourished. children to be anemic, out of which 67.3% as severely anemic and 13.8% as moderately anemic.[14] In another study by R kumar et al 88.5% children had anemia, 24% had severe anemia and 55.7% had moderate anemia.[15]

Table 2: Hematological Profile of SAM versus Control.

Hematological parameter	SAM mean±SD	Control mean ±SD	t-value	p-value
Haemoglobin (gm/dl)	7.17±2.265	9.22±3.362	7.18	<0.0001
RBC count (million/$mm^{3)}$	2.962±1.0059	3.32±0.877	3.83	<0.0001
Hematocrit (%)	21.27±6.63	27.40±8.98	7.73	<0.0001
Mean corpuscular volume (fl)	73.70±14.85	87.30±7.84	3.81	<0.0001
Mean corpuscular hemoglobin (pg/cell)	25.00±5.85	26.53±8.98	2.73	0.007
Mean corpuscular hemoglobin concentration (gm/dl)	33.36±3.00	34.04±1.20	2.97	0.003
Red cell distribution width (%)	39.62±78.08	13.24±1.83	2.09	0.027
Total leukocyte count ($\times10^3/mm^3$)	12.1±11.5	6.2±7.8	18.43	0.001
Neutrophil count (n %)	56.50±46.89	42.10±7.50	1.38	0.167
Lymphocyte count (l %)	54.53±19.42	59.30±6.82	3.273	0.001
Platelet count ($\times10^5/mm^3$)	2.89±1.32	3.02±1.02	1.09	0.275

Anemia associated with severe malnutrition is the consequence of multiple factors and represents an interaction between adaptation to inadequate food intake and the impact of other stresses associated with infection or dietary imbalance.[16] Lower mean values were observed for hemoglobin and hematocrit in children with SAM as compared to controls, a finding similar to previous studies.[13,17,18] Statistically significant lower values were also found for RBC count, PCV, MCV, MCH and MCHC in children with SAM. These red cell changes may be attributed to adaptation to lower metabolic oxygen requirements and decrease in lean body mass seen in PEM.[19] Changes in the plasma volume and intracellular water may also be responsible for changes in red cell indices.[8,20] Micronutrient deficiencies such as iron, zinc and copper have also been implicated as a contributory factor.[21]

In present study, it was found that significant leucocytosis and neutrophilia among children with SAM as compared to controls and the results were similar to previous studies.[8] Leucocytosis in these children may be as a result of infection which is seen commonly in association with PEM.[8] However, several other studies revealed leucopenia as well as neutropenia as a common finding in malnutrition.[22,23] Lower lymphocyte counts were observed in the malnourished children compared to controls. The lower lymphocyte counts may be attributed to thymic atrophy, which occurs in children during severe PEM. The degree of thymic atrophy correlates closely with depletion of lymphocytes.[24]

Mean value of platelet count was lower in cases as compared to controls but it was not statistically significant. A similar finding has been reported by Saka et al and Uner et al.[13,20] This decrease in platelets seen in severe acute malnutrition may be attributed to purported decrease in bone marrow activities which indirectly affect megakaryocyte functions.[20] In contrast to our finding, study conducted by Abdur Rehman et al reported a higher mean platelet count in children with SAM.[25]

CONCLUSION

It was concluding that nearly all patients with severe acute malnutrition had anaemia as a common co-morbid condition. Most of them suffered from moderate to severe anaemia. Children with SAM had significantly lower red cell indices, platelet count and a higher white cell count as compared to controls.

Protein energy malnutrition is a condition that constantly modifies the body's defence mechanism and thus altering the haematopoiesis at all levels. This study recommends that more frequent studies should be done to describe the trend of hematopoietic changes in children with SAM to enhance anticipatory care and outcome of the children affected.

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