A Comparative study of Hematological Profile and Etiology of Anemia in Patients From Nutritional Rehabilitation Centre with patients from General Pediatric Ward in M.G.M. Hospital, Warangal

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ABSTRACT

Severe acute malnutrition results in a spectrum of pathological changes in the body including substantial aberrations in hematological system. Aim of the study was to compare children from nutritional rehabilitation center with children from general ward with respect to: hematological profile, prevalence, etiology and severity of anemia. A cross sectional analytical study was done on 350 children aged from 6 to 59 months admitted in M.G.M. Hospital, Warangal. The prevalence of anemia in cases from nutritional rehabilitation center was 89.0% and 45.7% in cases from general ward. 82% cases from nutritional rehabilitation center had microcytic hypochromic picture and 67.4% cases from general ward had normocytic normochromic picture in peripheral smear. Iron deficiency was the most common cause of anemia in both groups, i.e., 92.3% cases from nutritional rehabilitation center and 46.2% cases from general ward. Megaloblastic anemia in 6.5% cases from nutritional rehabilitation center and 7.5% cases from general ward.

Keywords: Severe acute malnutrition, Anemia, Nutritional rehabilitation centre

Introduction

India is a country with a large population most of which falls in lower socioeconomic strata. Hence it is not uncommon for pediatric health sector professionals to come across children with severe malnutrition especially in public hospitals. Malnutrition in India is a silent killer and our country has one of the highest incidences of malnutrition in the world. [1] Of all the "under 5" children worldwide, it is expected that approximately half of children with Severe Acute Malnutrition (S.A.M.) reside in India.[1] More than 5 million children die in India annually as a direct or indirect consequence of malnutrition which implies that one child succumbs to it every ten seconds. [2] Currently the protocol for management of S.A.M. is the World Health Organization (W.H.O.) treatment regimen, administered by qualified health care experts in two phases: stabilization phase and rehabilitation phase.[3]

S.A.M. results in a spectrum of pathological changes in the body including substantial aberrations in the hematological system. Low red blood cell counts and subsequent anemia is a salient feature of severe acute malnutrition. The anemia may be normochromic normocytic, microcytic hypochromic or macrocytic based on the etiology.[4, 5] Leukocyte count reveals the synergistic association that S.A.M. has with infections and thymic atrophy. [6]

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In India, there is a lack of statistics on the hematological profile of S.A.M. when compared to other children. So, this study was taken on to ascertain hematological abnormalities of children admitted at our nutritional rehabilitation centre (N.R.C.) while comparing the same with children from general pediatric ward; the main idea of the analysis being an improved knowledge of hematological complications of malnutrition.

The study aims to compare children with severe acute malnutrition from nutritional rehabilitation centre with children from general pediatric ward in Mahatma Gandhi Memorial (M.G.M.) Hospital, Warangal affiliated to Kakatiya Medical College (K.M.C.), Hanumakonda with respect to:

1. Hematological profile

2. Prevalence of anemia

3. The etiology and severity of anemia when established

4. Differences if any in the above groups

Materials and Methods

Study population:

Inclusion criteria

For Group 1- Children aged from 6 months to 59 months having satisfied W.H.O. criteria of definition of S.A.M. and admitted in N.R.C. in M.G.M. Hospital, Warangal.

For Group 2- Children aged from 6 months to 59 months selected by simple random sampling and not having satisfied W.H.O. criteria of definition of S.A.M. and admitted in general pediatric ward in M.G.M. Hospital, Warangal.

Exclusion criteria

Any patient whose parents/guardian did not give consent to be a part of the study.

Sample Size : 350 children (i.e. 175 children in each group) who fulfilled the inclusion criteria were selected by consecutive sampling.

Type of Study: The research was a cross sectional analytical type of study.

Study period and source of Data Collection:

Children aged from 6 to 59 months having satisfied the inclusion criteria and admitted in the Department of Pediatrics at M.G.M. Hospital, Warangal between November 2019 to October 2021.

Method Overview

Children fulfilling inclusion criteria and admitted to N.R.C./General Pediatric ward were listed and their details were entered in a predesigned case record form. First section of the form included columns dealing with historical data i.e., basic and demographic data, information about living background, primary caregiver, schooling, clinical presentation, past history, family history, antenatal and birth history, medical history in mother and nutritional data.

Second section of the form had details of anthropometric examination of the child and the same checked for fitting into W.H.O. criteria for severe or moderate acute malnutrition. An infantometer, a stadiometer, a pocket measuring tape and a mechanical weighing scale were used for this assessment.

Third section had columns regarding results of complete hemogram for which under aseptic conditions, 3 ml of venous blood was collected into a sample bottle containing ethylene diamine tetra acetate (E.D.T.A.) and gently mixed to prevent clotting. The sample was analyzed using an automated blood analyser. Peripheral blood smears were looked into and other laboratory tests were done to find out the type of anemia if required. Severity of anemia was graded according to W.H.O. criteria. The section contains values of hemoglobin, red blood cell count, red blood cell indices, red blood cell distribution width, hematocrit, total leukocyte count, differential count, platelet count, reticulocyte count and peripheral smear. Reports of blood grouping and typing, serum iron studies, vitamin B12 and folate assays, stool sample assessment for ova and cysts, hemoglobin electrophoresis, sickling test, smear for malarial parasites were included for all cases. If clinically indicated additional tests like glucose-6-phosphate dehydrogenase (G-6-P.D.) levels, direct Coomb's test, bone marrow aspiration/biopsy were undertaken and results obtained were entered into the proforma.

Last section of the case record form had details about clinical outcome and management given during the stay. All the data from the forms was confirmed again and then the verified data for the two study groups was tabulated in two separate data sheets made using Microsoft Excel and then analysed by standardised methods as mentioned later.

Statistical methods applied:

Data was entered into Microsoft Excel (Windows 10; Version 2019) and analysis was done using Tableau software (version 2021.4; Tableau Software. Inc, Seattle, Washington, U.S.). Descriptive statistics such as mean and standard deviation (S.D.) for continuous variables, frequencies and percentages were calculated for categorical variables were determined. Association between variables was analyzed by using Chi-Square test for categorical variables. Unpaired t-test was used to compare mean of quantitative variables. Level of significance (p value) was set at 0.05.

Ethical issues:

Informed consent of parents was taken after explaining in detail about the methods and procedures involved in the study in their own local language. Institutional Ethical Committee clearance was taken before the study was undertaken.

Results and Discussion

A two-year hospital based cross sectional analytical study was done to compare the hematological profile and etiology of anemia in cases from N.R.C. with cases admitted in the general pediatric ward in M.G.M. Hospital, Warangal which is attached to Kakatiya Medical College, Hanumakonda. 175 children were enrolled in each of the two study groups. There were no cases enrolled in months of April and May 2020 and there was a dip in cases enrolled in May 2021 for the data from N.R.C. which correspond to the time periods of local/national lockdown protocols for preventing the spread of COVID-19 pandemic.

The mean age of enrolled cases in N.R.C. was 23 months and for the general pediatric ward was 25 months. Poor weight gain (21.5%) was the most common complaint for cases in N.R.C. whereas fever (63.4%) was the most common complaint for cases from the general pediatric ward. Maximum cases had outcome as discharged in both study groups: N.R.C. (86.9%) and general pediatric ward (87.4%). Most cases from N.R.C. stayed for a minimum period of 14 days (42.9%) whereas most cases from the general ward had their outcome in less than 7 days (55.4%). Infections (44.7%), severe anemia (24.4%) and severe pneumonia (18.7%) were the most common complications noted in cases from N.R.C. Fever as a complaint of infection in cases from N.R.C. was found to be not significant, likely due to the reductive adaptation.

The analysis of the clinical data from the cases showed the following parameters as risk factors to be admitted in N.R.C., i.e., the p value of the following was significant (less than 0.05): female gender, age group of 12-24 months, anemia at admission, very low birth weight, past history of admission in NICU, if there is history of admission of a sibling previously in N.R.C., history of anemia in mother, history of blood transfusion in the mother, dietary protein deficit of >25%. The analysis of the clinical data from the cases showed the following parameters were not risk factors to be admitted in N.R.C., i.e., the p value of the following was not significant (more than 0.05): rural background, preterm delivery, LSCS mode of delivery, age of mother <18 or >30 at delivery, consanguinity in the parents, birth order >2, primary caregiver not being mother, presence of infection at admission.

The prevalence of anemia in cases from N.R.C. was found to be 89.0% whereas it was 45.7% in cases from the general pediatric ward. In anemic cases from N.R.C. 3.2% had mild anemia, 66.5% had moderate anemia and 30.3% had severe anemia. In anemic cases from the general pediatric ward 17.5% had mild anemia, 63.8% had moderate anemia and 18.7% had severe anemia. Maximum cases (82%) from N.R.C. had microcytic hypochromic picture whereas maximum cases (67.4%) from general ward have normocytic normochromic picture in peripheral smear.

Iron deficiency was the most common cause of anemia in both groups, i.e., 92.3% cases of anemia from N.R.C. and 46.2% cases from general ward. Few iron deficiency cases had coexisting hookworm infection. Megaloblastic anemia caused 6.5% cases of anemia from N.R.C. and 7.5% cases from general ward. Complicated malaria was the most common infective cause for anemia i.e., in 1.3% cases from N.R.C. and 12.5% cases from general ward. Other significant causes of anemia in cases from pediatric ward were hemolytic anemias (18.2%, of which one case was autoimmune hemolytic anemia) and acute bleeds like epistaxis, hematuria, hemarthrosis, melena (6.2%)

Significantly lower mean values of hemoglobin, red blood cell count, hematocrit, mean corpuscular volume, mean corpuscular hemoglobin and mean corpuscular hemoglobin concentration, serum iron, serum ferritin, transferrin saturation, folate levels were noted in cases from N.R.C. when compared to cases from the general pediatric ward. Significantly higher mean values of red cell distribution width, total iron binding capacity and platelet count were noted in cases from N.R.C. when compared to cases from the general pediatric ward. There was no significant difference in mean of reticulocyte count, white blood cell count, vitamin B12 levels of both the groups in our study.

Table-1: Peripheral Smear findings about red blood cells

N.R.C. (N=175)			General Pediatric Ward (N=175)		
Peripheral Smear Findings	**No.**	**%**	**Peripheral Smear Findings**	**No.**	**%**
Microcytic hypochromic	143	82.0	Normocytic normochromic	118	67.4
Normocytic normochromic	22	12.0	Microcytic hypochromic	43	24.6
Macrocytic normochromic	10	6.0	Macrocytic normochromic	6	3.4
			Microcytic normochromic	8	4.6
p < 0.001					

Table- 2: Peripheral Smear: Other findings

N.R.C. (N=123)			General Pediatric Ward (N=58)		
Peripheral Smear Findings	**No.**	**%**	**Peripheral Smear Findings**	**No.**	**%**
Pencil cells	59	48.0	Pencil cells	19	32.8
Tear drop cells	22	17.9	Target cells	9	15.5
Target cells	20	16.3	Hypersegmented neutrophils	6	10.3
Thrombocytopenia	11	8.9	Skills cells	6	10.3
Hypersegmented neutrophils	10	8.1	Howell jolly bodies	4	6.9
Neutrophilic leukocytosis	1	0.8	Anisocytosis	4	6.9
			Nucleated RBCS	4	6.9
			Pancytopenia	3	5.2
			Others*	3	4.1
			*Lymphoblasts, Leukopenia		

Table- 3: Etiology of anaemia

N.R.C. (N=155)		General Pediatric Ward (N=80)	
Etiology of Anemia	**Frequency**	**Etiology of Anemia**	**Frequency**
Iron deficiency anemia with or without hookworm infection	143	Iron Deficiency Anemia	37
Folate deficiency anemia	4	Falciparum malaria	9
Vitamin B12 anemia	4	Thalassemia major	6
Falciparum malaria	2	Anemia of chronic disease	3
Folate deficiency with Vitamin **B**12 deficiency anemia	2	Folate Deficiency Anemia	3
		Sickle Cell Anemia	3
		Sickle Thalassemia disease	3
		Vitamin B12 deficiency anemia	3
		Acute Blast Crisis	2
		Acute Bleed	5
		Thalassemia minor	2
		Others*	4

*Autoimmune hemolytic anemia, Bone marrow failure syndrome, post viral bone marrow depression, vivax malaria

Table -4: "P" Values (χ2 Test) of Clinicopathological Parameter

Parameters	'P' values based on χ2 test	Significant	Not Significant
Female gender	0.05	Significant	---
Age at Admission: 12-24 months	0.005	Significant	---
Anemia	<0.001	Significant	---
Rural Background	0.95	---	Not Significant
B Positive Blood Group	0.039	Significant	---
Preterm Delivery	0.2	---	Not Significant
LSCS Mode Of Delivery	0.35	---	Not Significant
Very Low Birth Weight	<0.001	Significant	---
Age of Mother < 18 at delivery	0.705	---	Not Significant
Age of Mother > 30 at delivery	0.317	---	Not Significant
Past History of admission in NICU	0.0011	Significant	---
Past History of admission in PICU	<0.001	Significant	---
Past History of blood transfusion	0.01	Significant	---
History of sibling admitted in N.R.C.	0.0032	Significant	---
History of anemia in mother	<0.001	Significant	---
History of transfusion in mother	<0.001	Significant	---
History of consanguinity in parents	0.868	---	Not Significant
Primary caregiver is not mother	0.999	---	Not Significant
Birth Order > 2	0.54	---	Not Significant
Dietary Protein Deficit >25%	<0.001	Significant	---
Presence of infection during admission	0.25	---	Not Significant
Fever as a complaint of infection	0.48	---	Not Significant

Table -5: Mean and Standard Deviations of Hematological Parameters

Hematological parameter	Mean ± SD	
	N.R.C.	**General Pediatric Ward**
Hemoglobin (gm%)	8 ± 2.2	10.7 ± 3.3
Red Blood Cell Count (million per cubic mm)	2.92 ± 0.58	4.45 ± 0.8
Mean Corpuscular Volume (femtoliter)	60 ± 20.3	79.2 ± 18.3
Mean Corpuscular Hemoglobin (picograms)	23.5 ± 4.1	28.4 ± 3.5
Mean Corpuscular Hb Concentration (gm/ per dL)	25.6 ± 3.9	32.9 ± 3
Hematocrit (%)	23.9 ± 3.8	32.5 ± 9.8
Red Cell Distribution Width (%)	17.8 ± 4.2	13.4 ± 2
White Blood Cell Count (per cubic mm)	7650 ± 3590	7890 ± 3910
Platelet Count (lakhs per cubic m.)	3.47 ± 1.8	2.77 ± 1.5
Reticulocyte Count (%)	1.7 ± 0.6	1.5 ± 0.6
Serum Iron (pico grams per dL)	40.8 ± 32.2	79.6 ± 33.2
Total Iron Binding Capacity (micrograms per litre)	530.2 ± 107.3	375.9 ± 105.1
Transferrin Saturation (%)	13 ± 11.3	28.1 ± 12.4
Serum Ferritin (micrograms per litre)	47.4 ± 78.1	274.6 ± 361
Vitamin B12 Levels (picograms per millilitre)	385.6 ± 129.5	392.4 ± 110.2
Folate Levels (nanograms per millilitre)	7.9 ± 2.8	10.3 ± 2.9

Table 6: Comparison of data with study by Arya et. al.[7]

Hematological Parameter	Dr. ARYA et.al. (2017)		Present Study (2021)	
	SAM Mean ± SD	**Control Mean ± SD**	**N.R.C. Mean ± SD**	**General Ward Mean ± SD**
Hb (gm %)	7.17 ± 2.265	9.22 ± 3.362	8 ± 2.2	10.7 ± 3.3
RBC Count (mm /cu mm)	2.962 ± 1.0059	3.32 ± 0.877	2.92 ± 0.58	4.45 ± 0.8
MCV (fL)	73.70 ± 14.85	87.30 ± 7.84	60 ± 20.3	79.2 ± 18.3
MCH (pg)	25.00 ± 5.85	26.53 ± 8.98	23.5 ± 4.1	28.4 ± 3.5
MCHC (g/dL)	33.36 ± 3.00	34.04 ± 1.20	25.6 ± 3.9	32.9 ± 3
HCT (%)	21.27 ± 6.63	27.40 ± 8.98	23.9 ± 3.8	32.5 ± 9.8
RDW (%)	39.62 ± 78.08	13.24 ± 1.83	17.8 ± 4.2	13.4 ± 2
WBC Count (per cu. mm.)	12.1 ± 11.5	6.2 ± 7.8	7650 ± 3590	7890 ± 3910
Platelet Count (lakhs/cu mm)	2.89 ± 1.32	3.02 ± 1.02	3.47 ± 1.8	2.77 ± 1.5

Conclusion

The present study throws light on the hematological complications of malnutrition and raises a question to the public health sector i.e., how effective are we in interventions such as iron supplementation to avert them in the population, especially the under five children. We have found only two articles published in pediatric journals worldwide which have dealt specifically with the hematological aspects of malnutrition in an Indian scenario. Larger multicentric studies are required to be conducted to establish their prevalence in our country for more accurate results to standardise national screening programs and interventions for their prevention among under five children.

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