

Research Article

Anaemia in the Paediatric Age Group: Clinicohematological Findings and Trends

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ABSTRACT: Introduction: Anemia is a considerable public health issue affecting children globally, particularly in developing countries. It leads to impaired cognitive and physical development, increased infection risk, and poor quality of life. Nutritional deficiencies, particularly iron deficiency, are the primary causes of pediatric anemia. This study aims to evaluate the clinical, hematological, and biochemical profiles of anemia in the pediatric population, and to analyze the relationship between anemia, nutritional status, and socioeconomic factors. **Methods** A Cross-sectional study was conducted in the Department of Paediatrics. Infants between 6 months to 12 months who are admitted in an inpatient ward. Infants of age group between 6 months to 12 month admitted to hospital were included. Infants who have H/O Bleeding disorder, H/O Blood transfusions, Hemolytic anemia, acute blood loss were excluded. The parents were interviewed for collection of necessary information using the pre-tested, semi structured questionnaire method. The questionnaire was prepared by a thorough review of literature. **Results** The present study included 100 cases (100%), of which 59 cases (59%) were male and 41 cases (41%) were females. Most common age group affected was 1-5 years of age group with maximum 16 cases (15.6%). Microcytic Hypochromic, Normocytic Normochromic anemia, Normocytic hypochromic anemia, Macrocytic Hypochromic anemia & Macrocytic Normochromic anemia, were reported in 48.9%, 22.2%, 13.3%, 8.9% & 6.7% respectively. Iron deficiency anemia was the commonest nutritional deficiency anemia seen in 39 cases (39%). Anemia of chronic inflammation/infection was the second most common etiology of anemia with 24 cases (24%). **Conclusions** Besides haematological investigations for typing of anemia, Haemoglobin electrophoresis establishes the disease in haemoglobinopathies. Adequate health and healthy nutritional habits and prescription of Iron supplements are of great importance in prevention and management of anemia in children assisted by public health services

Keywords: Complete hemogram Microcytic hypochromic anemia Iron deficiency anemia Acute gastroenteritis.

INTRODUCTION

Pediatric anemia is one of the major health burden in India and in major parts of the world, as it results in reduced exercise tolerance, slower rate of growth, impaired development and delayed wound healing. [1] Anemic children are also at a higher risk of death due to complications associated with malnutrition and infection. Prevalence rate of anemia is an essential indicator of the nutritional status within the pediatric population. In the United States, around 18% of the children and in the developing countries about 82% of the children are anemic. [2] Because of these factors, the study of the etiopathogenesis of anemia in infancy and childhood has attracted wide attention in the recent years in India. [3] In most children, anemia is asymptomatic but has abnormal hemoglobin levels on routine screening. A child with anemia would not always have pallor or all other related symptoms, so

acquiring a complete history and elucidating proper physical examination can help in identifying the cause of anemia. [4] The iron stores are easily restored during the first few months of life even when the hemoglobin levels tend to fall. Thus iron deficiency is very rare to induce anemia until the reach of six months. Glucose-6-phosphate dehydrogenase (G6PD) deficiencies occur more commonly in males. [5] Habits Pica or geophagia usually results in iron deficiency. History of recent drug use may suggest G6PD deficiency or aplastic anemia and so does viral illness cause red cell aplasia. Recurrent diarrheal episodes show suspicion of malabsorptive occult blood loss that occurs in inflammatory bowel disease. [6] The physical examination constitutes an important aspect, but is essentially normal in most children with anemia. Findings that suggest chronic anemia include

irritability, pallor, glossitis, a systolic cardiac murmur, delayed growth and changes in the nailbed. [7] Acute anemia presents clinically with jaundice, splenomegaly, tachypnoea, hematuria, tachycardia and even congestive heart failure. Anemia is defined as a reduced hemoglobin concentration as compared to the levels in age-matched controls. In screening situations, when anemia is encountered, the patient should undergo a complete blood count evaluation (CBC). Anemia can be classified into microcytic, normocytic and macrocytic types based on the Mean Corpuscular Volume (MCV) estimation. [8] Next, anemia work-up includes peripheral smear examination and reticulocyte count measurement. Peripheral smear indicates the etiology of the anemia based on the red cell morphology. Basophilic stippling representing clumped ribosomes is in thalassemia syndromes, iron deficiency anemia and lead poisoning. [9] Howell-Jolly bodies (nuclear fragments) are noted in asplenia, pernicious anemia and

severe iron deficiency. The reticulocyte percentage is essential in segregating anemia due to decreased RBC production from a hemolytic anemia (increased RBC destruction). Bone marrow disorders or aplastic anemia show a low reticulocyte count, whereas a hemolytic process or active blood loss represents higher reticulocyte count. Corrected reticulocyte counts more than 1.5 indicate increased RBC production. [10] If the diagnosis is still not clear after the analysis of the initial laboratory findings, other confirmatory studies may be required. In very low MCV, serum iron level and total iron binding capacity (TIBC) estimation is suggested. In case of suspicion of hemolysis, G6PD assay, hemoglobin electrophoresis, direct Coombs' test, lactate dehydrogenase (LDH), and bilirubin (indirect) estimation may help in arriving at a diagnosis. Anemic children with an elevated MCV, require vitamin B12 and folate to be estimated in doubtful cases. [11].

MATERIALS AND METHODS

A Cross-sectional study was conducted in the Department of Paediatrics. Infants between 6 months to 12 months who are admitted in an inpatient ward.

Inclusion criteria

1. Parents of children willing to give informed consent.
2. Infants of age group between 6 mo to 12 mo admitted to hospital.

Exclusion criteria

1. Parents of children not willing to give informed consent
 2. Infants who have H/O Bleeding disorder, H/O Blood transfusions, Hemolytic anemia, acute blood loss.
- Method of data collection

- After obtaining approval and clearance from the institutional ethics committee, the individuals fulfilling the inclusion criteria were enrolled for the study.
- Informed written consent was obtained from all the parents/legal representatives of study subjects. To collect the required information from the parents the "Direct interview method" of Primary source of information technique was used. The parents were interviewed for collection of necessary information using the pre-tested, semi structured questionnaire method. The questionnaire was prepared by a thorough review of literature.

- In order to obtain co-operation of the patient/parent, they were made comfortable and a positive reinforcement was exerted. No answers were influenced and were helped during difficulty

- After taking the socio-demographic details like Age, Sex, Address, Maternal history and Feeding history of the infants were taken.

- Feeding pattern of the child from birth to present age like breast feeding, Complementary feeding was taken in detail.

- Socioeconomic status was assessed based on education, occupation, and incomes in the Modified Kuppuswamy's SES.

- All the study subjects were examined in detail and all the data was filled in the pro-forma.

- Venous blood sampling is obtained from each patient enrolled in the study and is sent for estimation of Complete blood count using automated analyzer from 2 ml of EDTA blood sample collected under sterile technique. Peripheral smear study was done with Leishman's stain and Reticulocyte count with New Methylene blue stain. Based on the blood picture, serum Ferritin, Vitamin B12 and folic acid levels were measured in the venous blood using Chemiluminescent technique, Serum iron was determined by calorimetric method and total iron binding capacity (TIBC) by Colorimetric were estimated. Anemia was diagnosed according to World Health Organization (WHO) criteria.

Microcytosis-90microM [8] Micronutrients cut off values according to Harriet lane age based values. [9] Folate deficiency 400mcg/dl increased, Sample size estimation was done using Open Epi software version.

Statistical analysis

Data was entered in excel sheet and analyzed using the Statistical Package for the Social Sciences 20 (SPSS Inc. Chicago). Sociodemographic data will be presented using descriptive statistics in the form of mean/proportion, median, standard deviation, interquartile range and percentage whichever is applicable. Chi-square test will be applied to test the association of various variables to the severity of anemia.

RESULTS

The present study included 100 cases (100%), of which 59 cases (59%) were male and 41 cases (41%) were females. Most common age group affected was 1-5 years of age group with maximum 16 cases (15.6%). (Table-1).

Table 1: Distribution of Total 90 Cases of Anemia According To Age & Sex:

Age Group (Years)	Male	Female	Total	Percentage (%)
0-1 Years	11	07	18	18%
1-5 Years	09	07	16	16%
5-8 Years	11	09	20	20%
8-13 Years	13	11	24	24%
13-18 Years	15	07	22	22%
Total	59	41	100	100%

Maximum number of 40 cases (40%) was of Moderate degree of anemia. (Table-2)

Table 2: Distribution of Cases According To Severity of Anemia In 100 Cases:

Age Group (Years)	Mild	Moderate	Severe
0-1 Years	08	11	06
1-5 Years	04	15	09
5-8 Years	03	06	07
8-13 Years	05	07	06
13-18 Years	03	04	06
Total	23	43	34
Percentage (%)	23%	43%	34%

Microcytic Hypochromic, Normocytic Normochromic anemia, Normocytic hypochromic anemia, Macrocytic Hypochromic anemia & Macrocytic Normochromic anemia, were reported in 48.9%, 22.2%, 13.3%, 8.9% & 6.7% respectively. (Table-3)

Iron deficiency anemia was the commonest nutritional deficiency anemia seen in 39 cases (39%). Anemia of chronic inflammation/infection was the second most common etiology of anemia with 24 cases (24%). Megaloblastic anemia, Dimorphic anemia, β Thalassemia major, Sickle cell anemia & Aplastic anemia (Fanconi's anemia) were seen in 6.7%, 8.9%, 14.4%, 3.3% & 3.3% cases respectively. (Table-3)

Table 3: Etiological & Morphological Classification of 90 Cases of Anemia:

Etiological/Morphological Type	NC/NC	NC/H C	Mic/HC	Mac/ NC	Mac/HC	Total
Nutritional anemia (53.4%)						
Iron deficiency anemia (35.79%)		09	30			39
Dimorphic anemia (10.80%)					10	10
Megaloblastic anemia (6.81%)				08		08
Anemia of Chronic inflammation/infection (27.84%)	14	05	05			24
Hemolytic anemia (17.62%)	05		11			16
Thalassemia (16.48%) Sickle cell anemia (1.14%) Aplastic anemia (1.14%) Fanconi anemia (1.14%)	03					03
Total	22	14	46	8	10	100
Percentage (%)	22%	14%	46%	8%	10%	100%

Weakness, easy fatiguability and irritability were the most common (71%) presenting symptoms in the present study followed by loss of appetite & weight with refusal of feeds (61%). (Table-5)

Table 4: Distribution of 90 Cases as Per Presenting Symptoms

Presenting symptoms	No of Cases	Percentage (%)
Weakness, easy fatiguability, irritability	71	71%
Loss of appetite and weight, refusal of feeds	61	61%
Fever	56	56%
Cough with or without expectoration	51	51%

Breathlessness and palpitations	45	45%
Pica	28	28%
Diarrhoea, vomiting	16	16%
Altered sensorium, convulsions	1	1%

Pallor was the commonest sign noted in all cases (100%) followed by tachycardia (83.3%) (Table-5)

Table 5: Distribution of 90 Cases According To Signs Observed

Signs	No of Cases	Percentage (%)
Pallor	99	99%
Tachycardia	76	76%
Signs of Malnutrition(Delayed milestones, failure to thrive, decreased weight for age)	74	74%
Hemic murmur	41	41%
Edema	21	21%
Splenomegaly	16	16%
Features of hemolytic facies i.e. frontal bossing, malar prominence	11	11%
Hepatomegaly	10	10%
Lymphadenopathy	7	7%
Signs of meningeal irritation	01	1%
Features suggestive of Fanconi’s anemia	01	1%

Table 6: HB, MCV and RDW Values in Iron Deficiency Anemia, Anemia of Chronic Infection and B Thalassemia Major

Type of Anemia		Hb gm%	MCV (fl)	RDW (%)
Iron deficiency Anemia	Range	6.9-13.9	53.4-78.2	15.6-30.7
	Mean	9.9	67.3	19.9
Anemia of chronic infection	Range	5.9 to 13.7	73.9-87.9	16.2-18.9
	Mean	9.8	79.0	17.7
B Thalassemia Major	Range	4.9 to 12.3	54.9-80.9	15.5 to 17.8
	Mean	8.58	67.8	17.8

The mean values of Hb were reduced in all three types of anemia. The mean values of MCV were much reduced in Iron deficiency anemia followed by β Thalassemia major and Anemia of chronic inflammation/infection. The mean RDW was strikingly raised in Iron deficiency anemia whereas near normal in Anemia of chronic inflammation/infection and β Thalassemia Major.

In cases of Iron deficiency anemia, the present study showed decreased values of Hb, MCV, MCH and MCHC and raised values of RDW compared to normal. In all cases of Iron deficiency anemia serum iron and serum ferritin levels were decreased while TIBC was raised.

In cases of Megaloblastic anemia, decrease in Hb, TLC, RBC, Platelets & Vitamin B12 values in all cases while MCV and RDW were raised in all cases.

DISCUSSION

According to WHO reports anemia is a serious global health problem specially affecting children and pregnant females with estimated prevalence rate 42% in under 5 children. It is more prevalent in developing countries with high prevalence rate - 51% in children between 0 -4 years and 46% between 5 – 12 years of age. [12] Prevalence of anemia in our study was 43% in children. NFHS survey 4 reported that prevalence of anemia in Indian fewer than 5 children is 58.4%. [13] In study by prevalence rate was 20.7% in school children aged between 6-15 years of age and 18% by Djokic et al. in school children aged between 4-15 years of age

while prevalence rate 52.88% reported by Sudhagandhi et al. and 37.6% by Assefa et al. [14] In our study male predominance was found, similar results were found in some studies but female predominance reported by other studies and in one study no difference was found in anemia prevalence between genders. Nutritional anemia was reported as commonest cause of anemia in children in this study. These results supported by many other studies especially from developing countries. [15] WHO estimated that iron deficiency anemia is responsible for 50% of cases of anemia in fewer than 5 children. [16] Other micronutrients (eg.- vitamin A, B12, folate and zinc) deficiency are also common culprit for nutritional anemia and it is advised by WHO that diet should be supplemented with these essential micronutrients. In both age group [6 month to 23

months and 2 to 12 years] food fortification with micronutrient rich powder advocated by WHO. [17] WFI [weekly iron and folic acid supplementation] program for fewer than 5 children and school aged children is a promising initiative by Government of India involving anganwadies and schools. [18] In our study pallor was not a very common finding in mild anemia but found as an important sign in severe anemia. Other studies had similar results. Fever was also a common presentation in our study as well as other studies. Lower respiratory infection is most common cause for admission in our study while another study by found acute gastroenteritis as a common reason for admission. Admission only because of anemia was in 25 children. History of deworming was given by many patients but worm infestation was reported in 12 patient which confirmed by stool examination in 2 patients. In our study malnutrition significantly associated with anemia and its severity. Childhood under nutrition alone is responsible for approximately 45% cases of fewer than 5 mortality according to WHO estimation. [20] Malnutrition was significantly associated with anemia and responsible for multiple micronutrient deficiency including iron, zinc, vitamin A, B12 and folate. It is suggested that more than one micronutrient deficiency was responsible for anemia in malnourished children and proper supplementation is must to improve outcome in these patients. [21] Infection was most common reason for admission in this study. Similar results were reported in other studies. It can cause sudden fall of hemoglobin due to hemolysis or decrease RBC production in bone marrow but many times underlying micronutrient deficiency is responsible for decrease immunity and exposed children to severe infection requiring hospitalization. Anemia is a risk factor for increased morbidity and prolongs duration of hospital stay in patient with infections. Pancytopenia is a very serious threat in hospitalized children. We found it in 10% and bicytopenia in 20% hospitalized children. Severe pancytopenia was present in 5 children and associated with poor outcome. Causes for pancytopenia were aplastic anemia, B12 deficiency, sepsis and hemolytic anemia. Some other studies from South Asia reported aplastic anemia, infection and hematological malignancies are common cause for pancytopenia. [22].

CONCLUSION

One of the major areas for improvement in primary health care is prevention of anemia because it has been associated with delay in psychomotor development especially in preschool age. Appropriate screening and subsequent diagnostic testing will allow most cases of anemia to be diagnosed at the earliest. Basal blood parameters are mandatory before treating children with anemia to avoid unwanted side effects. Anemia in association with malnutrition is widely prevalent in our country. So there is a need for urgent community participation strategies in the form of counseling the parents for child feeding practices, immunization and sickness recognition from the first year of life.

Preventive measures for anemia control in children must be accompanied by measures to prevent underweight and stunting by focusing on integrated child feeding, health and environmental core measures..

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