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A Study of Severe Anemia in Children in a Tertiary Care Institute

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Abstract

Introduction: The present study was to emphasize the chief causative factors, clinical manifestations, various hematological and morphological types in children with severe anemia, admitted to the pediatric wards of a tertiary care hospital. **Objectives**: The primary objective was to study clinical profile of severe anemia in children with various risk factor and hematological parameters among children with severe anemia. **Methods**: This was an observational study conducted in a tertiary health care institute. Children with severe anemia satisfying eligibility criteria with Hb less than or equal to 7gm/dl in age group 6 Month to 59 months. Less than or equal to 8gm/dl in age group 5 years to 14 years were included. Associated complaints and Clinical features were studied. Complete blood cell count with RBC indices- MCV, MCH and MCHC peripheral smear examination, reticulocyte count, stool examination, urine examination and Mantoux test were done in all patients. Serum ferritin, Hb electrophoresis, bone marrow examination, liver function test and renal function test, and x ray, U.S.G. abdomen, CT scan in relevant cases were done. **Result**: In this series 59 patients were included. Incidence of severe anemia was more in < 3.5 years age group (50.85%). Male to female ratio was 1.45:1. Out of 59 cases studied, 47(79.66%) had varying degrees of malnutrition. Pallor is the most prominent and characteristic sign noted in 59 cases (100%). Nutritional anemia was most common in 32 cases (55.93%) out of which 28 were microcytic and 4 were dimorphic. Associated infections were noted in 35 cases (59.32%). **Conclusion**: Nutritional deficiency is the most common cause of severe anemia especially iron deficiency anemia. Most of the children were malnourished and had infection indicating that severe anemia is directly related to malnutrition and infection. Pallor is the most consistent clinical sign of severe anemia. Severe anemia is more common in children aged < 3.5 years.

Keywords: Nutritional Deficiency Anemia, Pallor, Severe Anemia

1. Introduction

Anemia is generally defined as reduction of the hemoglobin (Hb) concentration or Red Blood Cell (RBC) volume below the range occurring in healthy person[1].

WHO Criteria for Dignosis of Anemia[2]

Age/gender groups	Hb(g/dl)
Children 6 months to 5 yrs	< 11
Children 6 yrs to 14 yrs	< 12

Grading of Anemia

Mild Hemoglobin percentage above 10 g/dl and below cut off value for age.

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Moderate Hemoglobin percentage is between 7 and 10 g/dl.

Severe Hemoglobin percentage is less than or equal to 7g/dl.

Hence severe anemia is said to be present if Hb (g/dl) is less than equal to 7g/dl.

2. Classification of Anemia

- Physiological Classification of Anemia.
- Classification Based of Red Cell Size.
- Classification Based on Mean Corpuscular Volume (MCV) and Red Cell Distribution Width (RDW).

2.1 Physiological Classification of Anemia[3]

2.1.1 Disorders of Red Cell Production in which Rate of Red Cell Production is Less than Expected for the Degree of Anemia

1. Marrow failure
   a. Aplastic anemia
      Congenital
      Acquired
   b. Pure red cell aplasia
      Congenital
         Diamond-Blackfan syndrome
         Ase's syndrome
      Acquired.
         Transient erythroblastopenia of childhood
         Others
   c. Marrow replacement
      Malignancies
      Osteoporosis
      Myelofibrosis
      Chronic renal disease
      Vitamin D deficiency
   d. Pancreatic insufficiency-marrow hypoplasiasyndrome
2. Impaired erythropoietin production
   a. Chronic renal disease
   b. Hypothyroidism,hypopituitarism
   c. Chronic inflammation
   d. Protein Energy malnutrition (PEM)
   e. Hemoglobin mutants with decreased affinity for
   f. Oxygen

2.1.2 Disorders of Erythroid Maturation and Ineffective Erythropoiesis

1. Abnormalities in cytoplasmic maturation
   a. Iron Deficiency Anemia (IDA)
   b. Thalassemia syndromes
   c. Sideroblasticanemias
   d. Lead poisoning
2. Abnormalities in nuclear maturation
   a. Vitamin B_{12} deficiency
   b. Folic acid deficiency
   c. Thiamine-responsive megaloblastic anemia
   d. Hereditary abnormalities in folate metabolism
   e. Oroticaciduria
   f. Primary dyserythropoietic anemia(type I,II.III,IV)
   g. Erythropoietic protoporphyrias
3. Refractory sideroblastic anemia with vacuolization of marrow precursors and pancreatic dysfunction/deficiency.

2.1.3 Hemolytic Anemias

1. Defects in hemoglobin
   a. Structural mutants
   b. Synthetic mutants
2. Defects in red cell membrane
3. Defects in red cell metabolism
4. Antibody mediated
5. Mechanical injury to erythrocyte
6. Thermal injury to erythrocyte
7. Oxidant induced red cell injury
8. Infectious agent induced injury
9. Paroxysmal nocturnal hemoglobinuria
10. Plasma lipid-induced abnormalities in the red cell membrane

2.2 Classification of Anemia on Red Cell Size[3]

2.2.1 Microcytic Anemias

1. Iron deficiency (nutritional, chronic blood loss)
2. Chronic lead poisoning
3. Thalassemia syndromes
4. Sideroblastic anemia
5. Chronic inflammation
6. Some congenital hemolytic anemia with unstable hemoglobin

2.2.2 Macrocytic Anemias

1. With megaloblastic bone marrow
   a. Vitamin B_{12}deficiency
   b. Diamond-Blackfan syndrome
   c. Hypothyroidism
   d. Liver disease
   e. Bone marrow infiltration
   f. Dyserythropoieticanemias

2.2.3 Normocytic Anemias

1. Congenital hemolytic anemia
   a. Hemoglobin mutants
   b. Red cell enzyme defects
   c. Disorders of red cell membrane
2. Acquired hemolytic anemia
   a. Antibody mediated
   b. Microangiopathic hemolytic anemia
   c. Secondary to acute infections
3. Acute blood loss
4. Splenic pooling
5. Chronic renal disease

2.3 Classification Based on Mean Corpuscular Volume (MCV) and Red Cell Distribution Width (RDW)[2]

3. Material and Methods

The present study is to emphasize the chief causative factors, clinical manifestations, various hematological and morphological types in children with severe anemia, admitted to the pediatric wards of a tertiary care hospital.

This observational study was conducted from August 2013 to December 2015 in department of pediatrics in a tertiary health care institute. Children with severe anemia satisfying eligibility criteria were included in the study- after obtaining informed written from patient's guardian. Detailed history was noted as per Proforma.

3.1 Investigations done in all patients (Annexure I)

1. Hb estimation by microns 60 auto analyser and Sahli's hemoglobinometer.
2. Hematocrit and RBC count were done using microns 60 auto analyser.
3. WBC count, differential count, & platelet count were done using microns 60 auto analyser.
4. RBC indices-MCV, MCH and MCHC using microns 60 auto analyser.
5. Peripheral smear examination using Leishman's stain.
6. Reticulocyte count by Brilliant Cresyl blue staining.
7. Stool examination.
8. Urine examination.
9. Mantoux test.

3.2 Special investigations (Annexure II)

1. Radiological investigations like X ray, U.S.G. abdomen, CT scan in relevant cases.
2. Serum ferritin
3. Hb electrophoresis
4. Bone marrow examination
5. Liver function test and Renal function test in relevant cases

Above investigations were done only in selected cases.

Data was analyzed using appropriate statistical software.

Table 1. Classification of Anemia Based on MCV and RDW

RDW	Low MCV	Normal MCV	High MCV
RDW <15	Thalassemia trait Heterozygous HbE,HbC, etc ACD	ACD Heterozygous HbE,HbC,HbS,etc Hereditary spherocytosis Acute hemorrhage	Aplastic anemia MDS Myeloma Liver disease Hyperthyroidism
RDW>15	Iron deficiency anemia Thalassemia intermedia ACD RBC fragmentation	Early nutritional deficiency Myelodysplasia Sickle cell disease	B_{12} deficiency Folate deficiency AIHA Drugs- hydroxyuria

Abbreviations: ACD-Anemia of Chronic Disease; MDS-Myelodysplastic Syndrome; AIHA-Autoimmune Hemolytic Anemia.

4. Results

In this series 59 patients were included. Incidence of severe anemia was more in < 3.5 years age group (50.85%). Male to female ratio was 1.45:1. Out of 59 cases studied, 47 (79.66%) had varying degrees of malnutrition. In the present study 14 (23.72%) cases were having Hb< 5g/dl. 45 (76.27%) cases in range of 5 g/dl to 7g/dl.

Pallor was the most prominent and characteristic sign noted in 59 cases (100%). Nutritional anemia was the commonest, 32 cases (55.93%) out of which 28 were microcytic and 4 were dimorphic. Associated infections were noted in 35 cases (59.32%) (Table 2-8).

Table 2. Age incidence in children studied

Age	No. of Cases	Percentage
0.5-3.5 yrs	30	50.85%
3.5-6.5 yrs	14	23.73%
6.5-9.5 yrs	8	13.56%
9.5-12.5 yrs	7	11.86%
Total	59	100.00%

Table 3. Sex incidence of children studied

Sex	No of cases	Percentage
Male	35	59.32%
Female	24	40.67%
Total	59	100%

Table 4. Nutritional status of children with severe anemia

PEM	No. of Cases	Percentage
Normal	12	20.34%
Grade 1	10	16.95%
Grade 2	13	22.03%
Grade 3	13	22.03%
Grade 4	11	18.64%
Total	59	100%

Table 5. Distribution of Hb in children studied

Distribution on HB	No. of Cases	Percentage
<5	14	23.73%
5-7	45	76.27%
Total	59	100.00%

Table 6. Morphological types of anemia

Types of Anemia	No. of Cases	Percentage
Normocytic hypochromic	6	10.17%
Normocytic normochromic	17	28.81%
Dimorphic	8	13.56%
Microcytic hypochromic	28	47.46%
Total	59	100.00%

Table 7. Associated disease in children with severe anemia

Disease	No. of Cases	Percentage
Respiratory tract infection	13	22.03%
IDA	7	11.86%
Dengue	5	8.47%
GI infection	4	6.78%
Renal/UTI	4	6.78%
CNS infection	3	5.08%
Liver disease	3	5.08%
ALL	3	5.08%
Malaria	3	5.08%
Thalassemia	2	3.39%
Sickle cell anemia	2	3.39%
CCF	2	3.39%
PEM	2	3.39%
Hypersplenism	1	1.69%
Aplastic anemia	1	1.69%
Lymphoma	1	1.69%
Hemophilia	1	1.69%
Septicemia	1	1.69%
ITP	1	1.69%
Total	59	100.00%

Abbreviations: IDA- Iron Deficiency Anemia, GI- Gastrointestinal, UTI- Urinary Tract Infection, ALL- Acute Lymphoblastic Leukemia, CCF- Congestive Cardiac Failure, PEM- Protein Energy Malnutrition, ITP- Immune Thrombocytopenic Purpura.

Table 8. Clinical feature seen in children studied

Clinical feature	Number of cases	Percentage
Pallor	59	100%
Fever	39	66.10%
Crepitations	15	25.42%
Edema	15	25.42%
Hepatomegaly	12	20.34%

Irritability	11	18.64%
Hepatosplenomegaly	10	16.95%
Xerosis	10	16.95%
Apathy	9	15.25%
Jaundice	7	11.86%
Hemic murmur	6	10.17%
Abdominal distension	4	6.78%
Bald tongue	4	6.78%
Frontal bossing	4	6.78%
Lethargy	4	6.78%
Tachypnea	4	6.78%
Altered sensorium	3	5.08%
Stomatitis	3	5.08%
Rachitic rosary	2	3.39%
Tachycardia	2	3.39%
Bleeding	1	1.69%

5. Discussion

Anemia is clinically defined on the basis of Hb level in the blood. According to WHO grading of anemia, severe anemia is hemoglobin level less than or equal to 7g/dl. Anemia is not a specific entity but it results from many underlying pathologic processes. Pallor is the most prominent and characteristic sign of anemia. It is best appreciated in skin, nailbeds, mucous membranes and conjunctiva.

5.1 Age Distribution

In the present study incidence of severe anemia was more in < 3.5years age group (50.85%). The lowest age for anemia recorded in this study was of a 6month old female child who was suffering from Iron deficiency anemia. The other age groups showed the following incidence, 3.5-6.5 yrs 14 cases(23.73%), 6.5-9.5 years 8 cases (13.56%) and 9.5-12.5 years 7 cases(11.86%).This observation is comparable to the study done by Saroja CN et. al.,[4] in 2015 (highest incidence 66%) and Deeksha Kapoor et. al.,[5] in 2002 (incidence 64%).

High incidence of malnutrition, bacterial infections, parasitic infestations and certain constitutional factors like hereditary anemia in this age group can explain the above observation.

5.2 Sex Distribution

A higher prevalence of anemia was noted in male children in this study. Male to female ratio was 1.45:1. This is comparable with studies done by Saroja CN et. al.,[4] 2015 (male:female ratio 1.96:1) and Madoori S et. al.,[6] 2015 (male:female ratio 1.20:1). The male predominance may be a sheer coincidence or may be because of increased concern of parents towards male children leading to increased incidence of male admissions.

5.3 Nutritional Status

IAP grading was used to classify PEM. Out of 59 cases studied, 47(79.66%) had varying degrees of malnutrition. Grade I PEM was seen in 10 cases (16.95%). Grade II in 13 cases (22.03%), Grade III in 13 (22.03%) and Grade IV in 11cases (18.64%). In the remaining 12 children (20.34%) the body weight was in normal range.

5.4 Associated Diseases

Tropical diseases resulting from bacterial infections and parasitic infestations create conditions favorable for anemia to develop and certain other diseases may be the direct cause of anemia. Also the associated diseases may be due to impaired resistance and decreased immunity in these children.

Associated diseases were found in some of the children in the study. Respiratory tract infections like bronchopneumonia and empyema were found in 13 children (22.03%).Gastrointestinal infections like Acute gastroenteritis were seen in 4 children (6.78%), CNS infections like meningitis were seen in 3 children (5.08%), Urinary tract infections were seen in 4 cases (6.77%), liver diseases were seen in 3 children (5.08%) and septicemia was seen in 1 case (1.69%).

6. Conclusion

This was a study of 59 cases of severe anemia (Hb equal to or less than 7g/dl) in infants and children admitted in pediatrics wards of Tertiary care center. Following conclusions were made

- Severe Anemia was common amongst Children below 3.5 years (50.85%) with a slight male preponderance (59.32%).
- Nutritional anemia was the commonest cause amongst children (55.93%) of which, Iron deficiency anemia (microcytic hypochromic) was 37.5% and dimorphic anemia was 23.52%.
- The next common cause was anemia due to blood loss, hemolytic anemia, anemia associated

with acute and chronic infections, aplastic anemia and leukemias.

- The clinical signs observed were pallor (100%) followed by pyrexia, hepatomegaly, splenomegaly, PEM, xerosis, edema, dyspnea, hemic murmur, icterus, nail changes, tachycardia, mental changes, CCF, cardiomegaly, frontal bossing, lymphadenopathy and bony tenderness in decreasing order of frequency.
- Protein energy malnutrition was seen in 79 percent of cases (IAP grading).
- Respiratory tract infections, gastrointestinal infections, and meningitis and skin lesions were the associated diseases present in the children.
- Based on peripheral smear examination microcytic hypochromic anemia was the commonest (47.45%), followed by normocytic normochromic anemia (27.11%), and followed by dimorphic and normocytic hypochromic in decreasing order of frequency.

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