

The Study of Anemia in Paediatric Patients in a Tertiary Care Hospital.

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Abstract

Background: Anemia is of frequent occurrence in children in different parts of the world and constitutes a major public health problem in the developing world due to its high socioeconomic implications. In young children it can result in impaired cognitive, behavioural, motor & language development, in addition to increased morbidity from infectious diseases.

Aim: To study the morphological pattern of anemia in paediatric age group.

Materials and Methods: This cross-sectional observational study was carried out in a tertiary care hospital on a total of 100 anaemic children. A predesigned proforma was used for data collection. Data was analysed using SPSS software.

Results: Anemia is commoner in females than in males in paediatric age with more affection of children less than 6 years. Mild to moderate anemia is commoner in the study area with microcytic hypochromic anemia commonest in 0-6year age-group and normocytic normochromic anemia commoner in older children (7-18 year).

Conclusion: Microcytic hypochromic anemia is the commonest morphological type in paediatric age group with iron deficiency being the most common aetiology, hence it is possible to correct anemia with combined supplemental iron and improved diet. Peripheral blood smear examination along with other RBC parameters are the cost-effective means of diagnosing most types of anemias.

Keywords: Anemia, Pediatric, Tertiary

Introduction

Anemia is of frequent occurrence in children in different parts of the world and poses a significant problem. It is of serious concern in young children because it can result in impaired cognitive performance, behavioural & motor development, coordination, language development and scholastic achievement, as well as increased morbidity from infectious diseases [1].

Anemia is functionally defined as an insufficient red blood cell (RBC) mass to adequately deliver oxygen to peripheral tissues [2]. In children, haemoglobin (Hb) values normally are less than those occurring in adolescents and adults. The physiologic difference is attributed to serum organic

phosphate levels which are higher in children as compared to adults. This hyperphosphatemia is associated with elevated erythrocyte 2,3-diphosphoglycerate content and thus the RBC oxygen affinity is decreased in children compared to adults. Thus, the lower Hb values in children may be due to altered Hb oxygen affinity [3].

At puberty, the Hb concentration in children reaches the same levels seen in adults. The higher Hb levels in males presumably are a reflection of the effects of androgen on erythropoiesis [2].

According to World Health Organisation (WHO) 2017 report anemia accounts for approximately 9% of the total global disability burden from all conditions and thus has significant consequences for human health as well as socioeconomic development [4].

Many observational studies have shown association between iron deficiency, iron deficiency anemia and poor cognitive & motor development outcomes in children. Iron deficiency causes alterations to brain structure and function, which may be irreversible even with iron treatment,

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particularly if the deficiency occurs during infancy when neurogenesis and differentiation of different brain regions are occurring [5]. Among anaemic children aged 5–12 years, iron supplementation improved global cognitive scores and intelligence quotient as well as measures of attention and concentration [6].

Anemia may be caused not only by deficiency of iron but can be due to deficiency of other nutrients such as folic acid and vitamin B12. Malaria and hookworm infestation also plays an important role in tropical climates. Congenital haemolytic diseases such as sickle cell anemia and thalassaemia found in certain populations, particularly in Africa, Asia and some Pacific islands rarely constitute a significant health problem [7]. Other causes of anemia, such as haemorrhage, infection and genetic disorders, may also be extremely important [8].

There is convincing evidence that anemia causes impaired growth, developmental delay, behavioral abnormalities and impairs cognitive function and school performance [9]. Hence, it is imperative to know the morphological pattern of anemia in children from our region to intervene at appropriate stage using standard treatment methods.

Aim and Objective

- To determine the morphological patterns of anemia in paediatric age-group
- To determine the correlation between morphological patterns and red cell indices.

Material and Methods

This cross-sectional observational study was carried out in the Department of Pathology in collaboration with Department of Paediatrics, Acharya Shri Chander College of Medical Sciences and Hospital, Jammu over a period of one year i.e., from 1st November 2018 to 31st October 2019. The study was approved by Institutional Ethics Committee.

A total of 100 anaemic children were included in the study after obtaining written consent. Based on the clinical history and physical examination, various haematological, biochemical, or other investigations were performed and a conclusion regarding the morphological pattern of anemia was derived.

Laboratory test carried out included Hb estimation, total leucocyte count (TLC), differential leucocyte count (DLC), platelet count, mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC). Peripheral blood smears were stained with Leishman's stain and reticulocyte count was studied on smears made with brilliant cresyl blue and whenever required, sickling test and glucose-6-phosphate dehydrogenase (G6PD) test was conducted.

Inclusion Criterion

All children aged 0 to 18 years presenting with anemia with haemoglobin values below the WHO reference values were included in the study [4].

Exclusion Criterion

Children on iron medications or children who are given blood transfusions or children of unwilling parents.

Under all aseptic precautions, venous blood was collected for the study. EDTA was used as an anticoagulant for hematological profile. Hb estimation, hematocrit, cell counts, and red cell indices were done using automated cell counter and reconfirmed by their respective manual methods. Reticulocyte count was done manually. Automated cell counter (Sysmex five-part differential) was used for cell counts and detecting size of cells. Haemoglobin estimation was done by using the standard cyanmethemoglobin method. Peripheral blood smear examination was carried out after staining the blood smear by Leishman's stain. The data was entered and analysed using computer software Microsoft Excel and SPSS version 21. Statistical difference was calculated using chi-square test. A p-value of <0.05 was considered as statistically significant. All p-values reported were two-tailed.

Observations and Analysis

In our study, majority of children (38%) were in 0-6 years age-group followed by 32% in 13-18 years and remaining 30% in 7-12 years age-group. Females (57%) outnumbered to males (43%) with a M:F ratio of 1:1.3. Mild anemia was present equally among males and females in our study, but a greater number of females suffered from both moderate and severe anemia as shown in Table 1.

Table 1: Distribution of Subjects according to Severity of Anemia and Gender

Degree of Anemia Hb (gm/dl)	Male n (%)	Female n (%)	p value (Chi-square test)
Mild >10	27(50)	27(50)	p =0.216
Moderate 7-10	14(37.83)	23(62.17)	
Severe <7	2(22.22)	7(77.78)	

Majority of the subjects i.e., 54% had mild anemia followed by moderate anemia in 37% and severe anemia in 9% subjects. As shown in Table 2, mild anemia was most frequent in 7-12 years age group; moderate anemia in 0-6 years age group and severe anemia in 13-18 years age group. This difference in degree of anemia was statistically significant in different age groups.

According to the peripheral blood smear findings, subjects were classified into following categories: microcytic, normocytic, macrocytic and dimorphic (both microcytic and macrocytic features) anemia. The commonest type of anemia was microcytic as shown in Table 3.

Cases with microcytic hypochromic appearance on PBF showed reticulocyte count in the range of 1.5 to 5.5%; cases with normocytic normochromic revealed reticulocyte count in the range of 0.5 to 2.5% and cases with macrocytic appearance revealed a reticulocyte count in the range of 1.0 to 3.0%.

Only in two cases with microcytic hypochromic appearance on peripheral blood film and high reticulocyte count, G6PD was found to be deficient.

In our study, 74 subjects had microcytic anemia with 35 males (47.3%) and 39 females (52.7%). In 0-6 years age

group, there were 38 subjects with microcytic anemia in all (100%). In 7-12 years age group, out of 30 subjects, 20 (66.67%) had microcytic and in 13-18 years age group, out of 32 subjects, microcytic anemia was seen in 16 subjects (50%). In our study, 18 subjects had normocytic anemia with 06 (33.33%) males and 12 (66.67%) females.

Normocytic anemia was not seen in 0-6 years age group. It was seen in 10 subjects (33.33%) in 7-12 years age group and 08 subjects (25%) 13-18 years age group.

Table 4 shows distribution of type of anemia based on age group, gender, and degree of anemia. From the table, it is evident that microcytic hypochromic anemia was most frequent in younger age group whereas normocytic normochromic was commoner in 7-12 year age group and above. Macrocytic and dimorphic anemia was seen in 13-18 year age group. There was no statistical difference with respect to gender distribution and type of anemia. Majority of cases of anemia were mild to moderate with few cases of severe anemia. In our study, only 2 subjects showed macrocytic anemia with both in 13-18 years age group and both were females. Dimorphic blood picture was seen in 6 children, all in 13-18 years age group with 2 males and 4 females.

Table 2: Distribution of subjects according to Severity of anemia and Age

Degree of Anemia	Age wise Distribution (n)			p value (Chi-square test)
	0-6 yrs	7-12 yrs	13-18 yrs	
Mild	15	25	14	p < 0.0001
Moderate	21	4	12	
Severe	2	1	6	

Table 3: Final Diagnosis based on Peripheral blood film

Peripheral Blood Film / Smear	No. of subjects	Percentage
Microcytic Hypochromic	74	74
Normocytic Normochromic	18	18
Macrocytic	2	2
Dimorphic	6	6

Table 4: Distribution of Types of anemia

Characteristic	Microcytic Hypochromic (%)	Normocytic Normochromic (%)	Macrocytic (%)	Dimorphic (%)	Total (%)
Age					
0-6 year	38	0	0	0	38
7-12 year	20	10	0	0	30
13-18 year	16	8	2	6	32
Gender					
Female	39	12	2	4	57
Male	35	6	0	2	43
Degree of Anemia					
Mild	37	14	0	3	54
Moderate	28	4	2	3	37
Severe	9	0	0	0	9
Total	74	18	2	6	100

Table 5: Distribution of Red Cell indices

Characteristic	Microcytic Hypochromic (%)	Normocytic Normochromic (%)	Macrocytic (%)	Dimorphic (%)	Total (%)
PCV					
Normal (36-42)	2	4	0	0	6
Decreased (≤ 35.9)	72	14	2	6	94
MCV					
Normal (80-100)	0	18	0	6	24
Decreased (< 79.9)	74	0	0	0	74
Increased (> 100.1)	0	0	2	0	2
MCH					
Normal (27-32)	0	4	0	0	4
Decreased (≤ 26.9)	74	14	0	6	94
Increased (> 32.1)	0	0	2	0	2
MCHC					
Decreased (< 30)	27	9	0	6	42
Normal (30-35)	47	9	2	0	58
RDW					
Normal (9-14.5)	27	16	0	0	43
Increased (> 14.6)	47	2	2	6	57
Total	74	18	2	6	100

As shown in Table 5, among 100 anaemic children, majority (94%) had low packed cell volume (PCV) with remaining having normal PCV. Most of the children (74%) had low MCV with 24% having normal and only 2% having increased MCV. 94% of subjects had decreased MCH values while only 4% had MCH in the normal range and increased in 2% subjects. In our study, 58% subjects had MCHC values in the normal range with remaining 42% having decreased MCHC values. In our study, 57% subjects had increased red cell distribution width (RDW) (> 14.6).

Discussion

Anemia is a frequent problem in children in different parts of the world impairing normal development and constituting a major public health problem among young children in the developing world with high socioeconomic implications. The highest prevalence of anemia exists in the developing world where its causes are multifactorial [10].

In our study of 100 anaemic children up to 18 years of age, females had higher proportion. Our results are in agreement with the study by Agravat *et al*, 2014 (Male-48%, Female-52%)[11]. However the results were different from the study by Rathna *et al*, 2014 [12] which had higher percentage of males (55%) than females (45%).

Majority of the subjects in our study were in 0-6 years age group (38%), followed by 32% in 13-18 years age group

and 30% in 6-12 years age group. This is similar to Suba *et al*, 2015 [13] in which most subjects were in 0-5 years age group i.e., 64% and 28% were in 5-14 years age group. However, in the study by Agravat *et al*, 2014, [11] majority of subjects i.e. 91% were in 0-5 years age group and only 09% in 6 to 12 years age group. This means that anemia is commoner in younger children.

In our study, majority of subjects (54%) had mild anemia followed by 37% moderate and 9% severe anemia. Devi & Singh, 2016 [14] had similar results in which mild anemia was present in 64.6% of children, moderate in 32.8% and severe anemia present in 2.6%. However the results were different from the study by Muthuraman & Sintha, 2017 [15] in which 4% subjects had mild anemia, 45.1% moderate and 50.9% subjects had severe anemia.

In our study, the commonest type of anemia was microcytic hypochromic. Our results were similar to Suba *et al*, 2015 [13] with 63% microcytic hypochromic anemia followed by 23% normocytic normochromic, 09% normocytic hypochromic, 04% dimorphic and 01% macrocytic. Also, the study by Agravat *et al*, 2014 [11] revealed that microcytic hypochromic is commonest seen in 61%, followed by dimorphic in 20%, macrocytic in 15% and hemolytic in 04% subjects. Kapoor & Aggarwal, 2002 [16] in their study also revealed that the most common type of anemia was microcytic hypochromic in 43.2% subjects,

followed by normocytic normochromic in 27%, normocytic hypochromic in 17%, macrocytic in 10% and dimorphic in 2.7% subjects.

In contrast to our study, Rathna et al, 2014 [12] showed that the most common type of anemia was normocytic normochromic in 55% subjects, followed by microcytic hypochromic in 27%, normochromic hypochromic in 11%, macrocytic 04% and dimorphic in 03% subjects.

In our study, based on red cell indices (i.e. MCV & MCH values), microcytic hypochromic anemia was found in 74% of subjects. These findings were similar to Garg et al, 2019 [17] with microcytic hypochromic anemia in 59.43% subjects. In our study, majority of the cases had microcytic hypochromic type of anemia with reduced MCV & MCH values but with MCHC in the normal range, similar to that seen in the study by Sandhya & Muhasin, 2014 [18].

Pearson correlation coefficient was used for analysing the correlation between the morphological pattern of anemia seen on PBF and red cell indices i.e. MCV, MCH & MCHC and p-value was found to be <0.05 (0.001, 0.002 and 0.021 respectively) implying highly significant correlation.

In our study, majority of cases had microcytic hypochromic anemia with raised RDW i.e. 47% and cases having normocytic normochromic anemia with normal RDW were 16%. These findings were similar to those seen in the study by Garg et al, 2019 (16) with 41.71% cases of microcytic hypochromic anemia with raised RDW followed by 19.43% of normocytic normochromic anemia with normal RDW.

Pearson correlation coefficient was used for analysing the correlation between the morphological pattern of anemia seen on peripheral blood film and RDW and p-value was found to be <0.05 (0.008) thus signifying inverse relationship between the morphological pattern of anemia seen on PBF and RDW values.

Conclusion

Anemia in pediatric age group is commoner in females and children less than 6 years of age. Mild to moderate anemia is commoner in study area with microcytic hypochromic being the most common morphological pattern in younger age group and normocytic normochromic in older children.

Patients with microcytic hypochromic anemia also show reduced values of both MCV & MCH and increased RDW. Hence, a careful evaluation of RBC indices is needed for categorisation of anemia.

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