Original Article

Hematological Survey in Pre-school Children with Special Reference to Iron Deficiency Anemia

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Abstract

Introduction: Anemia in children is a common health problem in developing countries. The most vulnerable group is the pre-school children living in rural as well as slum areas. The current study gives emphasis on utility of complete blood count for screening, and it's correlation with Iron profile studies for detection of iron deficiency anemia in pre-school children.

Aims and Objectives: To study the hematological profile and prevalence of iron deficiency anemia in children aged between 1-5 years.

Materials and Methods: A total number of 112 cases attending Rajah Muthiah Medical College Hospital Pediatrics Outpatient Department during the period of July 2007-July, 2009 were included in the present study. Venous blood samples were collected by venepuncture into containers with di-potassium ethylenediaminetetraacetic acid. All samples were analyzed for hematological parameters (erythrocyte count, hemoglobin, hematocrit, mean corpuscular volume [MCV], mean corpuscular hemoglobin [MCH] concentration [MCHC] and red cell distribution width [RDW]). Serum sample of randomly selected 12 children were analyzed for iron profile studies (serum ferritin [S. ferritin], serum iron [S. iron], total iron binding capacity [TIBC] and percentage saturation).

Results: A total of 112 cases were included in the study. The prevalence of anemia was found to be 73.2%. Out of 82 anemic pre-school children, 47 (57.31%) were found to be males and 35 (42.68%) were found to be females. Thus, male to female ratio in the present study was found to be 1.3:1. Hemoglobin value of pre-school children was <11 g/dl in 82/112 cases (73.2%). Mild degree of anemia was most common (40.2%), followed by moderate degree (22.3%). Majority of the cases (54%) showed reduced hematocrit reduced MCV, MCH and MCHC were noticed in 73.2%, 61.6% and 54.5% respectively. Increased RDW was noticed in 58.9 % of the cases. Classification of anemia was done using MCV and RDW and found that 58.9% came under microcytic heterogeneous type due to iron deficiency. Iron profile studies in 12 cases showed reduced S. ferritin (91.7%), S. iron (75%) and percent saturation (75%). TIBC was increased in 66.7% of the cases.

Conclusion: A significant correlation exists between hemoglobin, hematocrit, MCV, MCH, MCHC and RDW. Hemoglobin concentration below 11 g/dl in pre-school age group was found to be an effective screening test for selecting patients for further evaluation. Among the iron profile studies, S. ferritin measurement is the most sensitive indicator of iron deficiency.

Keywords: Anemia, Hemoglobin, Mean corpuscular volume, Red cell distribution width, Serum ferritin

INTRODUCTION

Anemia is one of the common problems encountered in clinical medicine. However, anemia is not a disease but rather the expression of an underlying disorder or disease.[1] Anemia is defined as a low-hemoglobin concentration or red blood cell mass compared to the age-specific norms.[2] Anemia is functionally defined as a decrease in the competence of blood to carry oxygen to tissues, thereby causing tissue hypoxia.[1]

Anemia in children is a commonest health problem in developing countries and frequent laboratory abnormality encountered in children.[3,4] The most vulnerable group regarding health and nutritional status are the pre-school children living in rural as well as slum areas, who are victims

of undernourishment.[4] Preschool denotes children aged 1-5 years.[5] Pre-school age is when brain development and physical growth is at its maximum acceleration, hence its importance.[4]

Iron deficiency is currently the most widespread micronutrient deficiency with an estimated prevalence of 43%.[6] Most children with anemia are asymptomatic and have abnormal hemoglobin or hematocrit level on routine screening. Anemia in infancy and early childhood is associated with behavioral and cognitive delays, including impaired learning, decreased social achievement, and low scores on tests of mental and motor development.[5] Given the detrimental long term effects, and high prevalence of nutritional deficiency, its prevention in early childhood is an important public health issue.[2]

The complete blood count is a test frequently done on children presenting to pediatric outpatient department, usually for consultation and the same can be utilized to screen for iron deficiency anemia at no additional cost. Additional biochemical tests may be done for confirmation after screening tests in these cases. The present study is on hematological parameters with special reference to iron deficiency anemia among pre-school children attending Rajah Muthiah Medical College and Hospital hailing from the rural community in and around Chidambaram, Tamil Nadu.

MATERIALS AND METHODS

A total number of 112 cases attending Rajah Muthiah Medical College and Hospital Pediatrics Outpatient Department during the period of July 2007-July, 2009 (2 years) were included in the present study and was cleared by Institutional Ethics Committee.

Sample Collection for Hematological Parameters

Blood was withdrawn from an ante cubital vein by means of dry sterile 5 ml, disposable plastic syringe with a needle of 20-gauge after preparing the cubital fossa with a sterile swab. 2 ml of blood was withdrawn, slowly. Immediately blood is transferred to sterile glass bottle with di-potassium EDTA as anticoagulant.

Sample was analyzed in an automated cell counter (MODEL and COMPANY: MYTHIC 18, ORPHEE SA, C2 DIAGNOSTICS, FRANCE) for complete blood counts (erythrocyte count, hemoglobin, hematocrit, mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCHC), red cell distribution width (RDW), Reticulocyte count and platelet count).

Sample Collection for Iron Profile Studies

The blood in the bottle without anticoagulant was allowed to clot without disturbances for 30-60 min at room temperature. Once the stable clot was formed, the serum separates out. The serum was taken through long pasteur pipette and centrifuged at 3000 RPM for 10 min, and the supernatant was taken into a sterile plastic radioimmunoassay tube and stored at −20°C. Sample was analyzed in an automated biochemical analyzer (equipment: Immulite 1006 systems, Diagnostic Product Corporation, USA and IMOLA–RANDOX) for iron profile studies (serum ferritin [S. ferritin], serum iron [S. iron], *total* iron binding capacity [TIBC]and percent saturation).

Inclusion Criteria

- Randomly selected children attending pediatric outpatient department aged 1-5 years during study period.

Exclusion Criteria

Children with:

- Acute infections
- Communicable diseases like HIV, tuberculosis hepatitis
- Other major and chronic illness. Hematinics support
- History of recent blood transfusion
- Known cases of hemoglobinopathies.

RESULTS

112 pre-school children were included in the study. 82 out of 112 cases (73.2%) were found to be anemic as per WHO definition. Out of 82 anemic pre-school children, 47 (57.31%) were found to be males and 35 (42.68%) were found to be females. Thus, male to female ratio in the present study was found to be 1.3:1. 60 cases (53.6%) had hematocrit <33%. Hemoglobin value of pre-school children was <11 g/dl in 82/112 cases (73.2%), and it was ≥11 g/dl in 30/112 cases (26.8%). Among pre-school children, a mild degree of anemia (9-11 g/dl) seen in 37.5% of cases, moderate degree of anemia (7.0-9.0 g/dl) seen in 22.3% of cases and 10.7% of cases were severely anemic (≤7.0). 82/112 (13.2%) had MCV below 80 fl, 15/112 (13.4%) had MCV within the normal range and 15/112 (13.4%) had MCV more than 100 fl. 69/112 (61.6%) pre-school children had mean corpuscular hemoglobin (MCH) below 25.9 pg, 37/112 (33.03%) had MCH within normal range (26.0-34.9 pg) and 6/112 (5.4%) had MCH more than 35.0 pg. 61/112 (54.5%) pre-school children had MCHC below 30.9 g/dl, 49/112 (43.8%) had MCHC within normal range (31.0-36.0 g/dl) and 2/112 (1.8%) had MCH more than 36.1 g/dl. 73.2 % of preschool children had decreased MCV (<80 fl). Classification of anemia was made on the basis of comparison of MCV and RDW with number of cases in each group (Figure 1).

Comparison between parameters of iron profile studies and between MCV, RDW and S. ferritin, were done in 12 randomly selected cases and illustrated in Figures 2 and 3 respectively.

DISCUSSION

Anemia in pre-school age group was defined and classified using WHO criteria (HgB <11 g/dl). Degree of anemia was classified as mild (9.0 ≤11.0 g/dl), moderate (7.0 ≤9.0 g/dl) and severe (<7 g/dl).[6] In the present study, prevalence of anemia was found to be 73.2% which was in concordance with other similar studies as shown in Table 1.

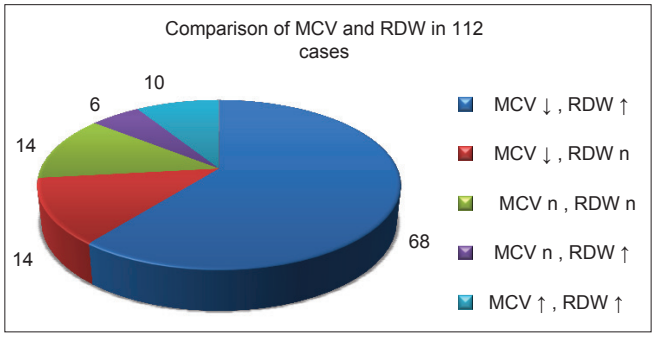

Figure 1: Comparison of mean corpuscular volume and RDW in 112 cases. (↑ - increased, ↓ - decreased, n - normal)

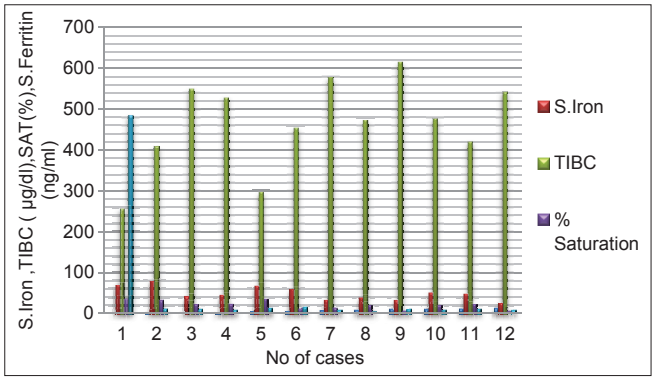

Figure 2: Comparison of Iron profile study in 12 cases

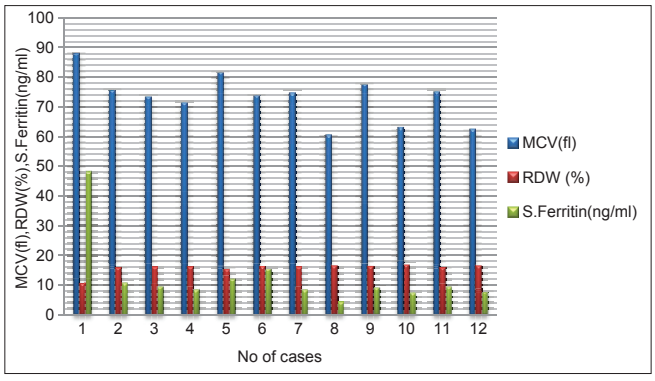

Figure 3: Comparison between mean corpuscular volume (MCV), red cell distribution width (RDW) and serum ferritin (S. ferritin). Comparison of MCV, RDW and S. ferritin values in each case showed two patterns. They were: (1) MCV ↓, RDW ↑, S. ferritin ↓. (2) MCV n, RDW n, S. ferritin n (↑ - increased, ↓ - decreased, n - normal)

Sex distribution of anemia was compared with studies conducted by Gomber *et al.*,[8] Kapur *et al.*[18] and Halileh *et al.*[19] as shown in Figure 4.

Degree of anemia was classified as mild (9 ≤11.0 g/dl), moderate (7 ≤9.0 g/dl) and severe (<7 g/dl). Mild degree of anemia was most prevalent (40.2%) in the present study followed by moderate (22.3%) and severe anemia (10.7%). The findings were in accordance with studies conducted by Gomber *et al.*[8] and Chakravarty and Ghosh.[13] Comparison of MCV and RDW were done and found out that 73.2% of children had decreased MCV (<80 fl) and 58.9% had increased RDW, which correlated with studies conducted by Patton *et al.*,[14] Oski *et al.*[11] and Pusic *et al.*[15]

Classification of anemia was made on the basis of MCV and RDW which was proposed by Bessman *et al.*[12] Anemia's are classified into six types - microcytic heterogeneous, microcytic homogeneous, normocytic homogeneous, normocytic heterogeneous, macrocytic homogeneous and macrocytic heterogeneous. In the present study, 68 pre-school children had microcytic heterogeneous type of anemia (MCV ↓, RDW ↑) due to iron deficiency.

Comparison of HgB and S. ferritin showed decreased S. ferritin in all stages of iron deficiency anemia and may be the first indication of developing iron deficiency anemia.[6] In the present study, all pre-school children with decreased HgB had decreased S. ferritin (100%). This is in

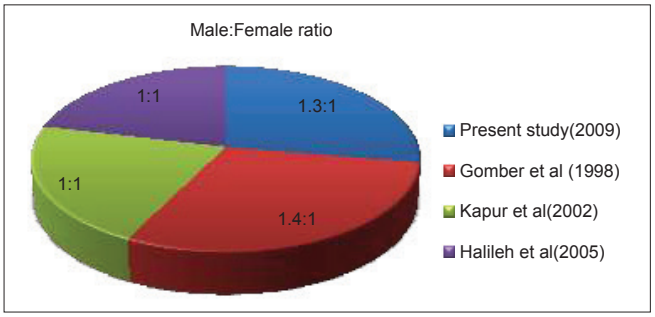

Figure 4: Sex distribution of anemia

Table 1: Comparison of prevalence of anemia

Authors (year)	Prevalence (%)
Herbert *et al.*[7] (1998)	72.5
Gomber *et al.*[8] (1998)	76
National Family Health Survey[9] (1998-1999)	74
Villalpando *et al.*[10] (2003)	72
Present study (2009)	73.2

concordance with Palafox *et al.* (2003), who concluded that comparison of S. ferritin and HgB can be used for detecting iron deficiency anemia.[16] Comparison of MCV, RDW and S. ferritin showed results similar to studies conducted by Hutcheson (1970) and Carlos *et al.* (2001), reported that decreased MCV and increased RDW along with decreased S. ferritin, increased TIBC, decreased S. iron and percent Saturation are confirmatory of iron deficiency anaemia.[17,18]

CONCLUSION

One of the major areas for improvement in primary health care is prevention of nutritional deficiency because it has been associated with delay in psychomotor development especially in pre-school 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. In the present study, a significant correlation was observed between hemoglobin, hematocrit, MCV, MCH, MCHC, RDW and biochemical parameters such as S. iron, TIBC, percent saturation and S. ferritin. HgB, MCV and RDW alone can be utilized for screening and classifying anemias even before doing peripheral smear or biochemical investigations. S. ferritin measurement is the most sensitive indicator of iron deficiency, which is decreased in all stages of iron deficiency anemia and, it is the first indicator of developing iron deficiency anemia even before the drop in hemoglobin. S. iron, TIBC and percent saturation determinants are also of help in the diagnosis of iron deficiency anemia along with S. ferritin.

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