Proceeding S.Z.P.G.M.I. vol: 16(1): pp. 19-23, 2002.

Frequency of Iron Deficiency in Children With Hypochromia and Microcytosis on Blood Smears

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SUMMARY

Objective: To see the frequency of iron deficiency in children with hypochromic and microcytic anaemias.

Design: Prospective study.

Place and duration of study: Department of Haematology Shaikh Zayed Hospital and FPGMI Lahore, Pakistan, from January 1993 to June 1993.

Subjects: 85 anaemic patients (60 male and 25 female) with MCV <76 fl/cell and MCHC <30 g/dl of red cells were included.

Methods: Blood counts were performed on Sysmex K1000 Haematology analyser, serum iron, TIBC colorimetrically and serum ferritin on ELISA method according to the instruction sheet of the manufacturer. Serum Ferritin concentration less than 12 ng/ml was taken as index of iron deficiency.

Results: Out of 85 patients 78 (92%) were iron deficient.

Conclusion: Iron deficiency was the commonest cause of hypochromia and microcytosis in children. No red cell parameters could be relied upon for the diagnosis of iron deficiency. Serum iron may be low or normal and TIBC raised or normal in patients with iron deficiency anaemia. The serum ferritin assay is the most sensitive and specific index for iron stores as compared to blood counts, serum iron and TIBC.

Key Words : Anaemia, Iron, Iron Deficiency, Serum Ferritin.

INTRODUCTION

Iron deficiency and anaemia are major nutritional concerns throughout the world. Iron deficiency has been associated with haematological changes (red blood cell deformation), stunted growth, altered thermoregulatory function, decreased cognitive function and prenatal iron adequacy is important for myelination in brain[1,2]. Iron is required for linear growth in children[3,4]. Infant mortality and still births are high in mothers with iron deficiency[5]. There is strong association between maternal haemoglobin concentration and birth weight as well as between maternal haemoglobin concentration and pre-term birth[6]. Iron deficiency anaemia has three stages to develop ,Iron depletion, Iron depletion without anaemia and iron deficiency anaemia[7]. Nutritional deficiency is an important cause of iron deficiency[8]. Haemoglobin (Hb), red cell (RBC) count, packed cell volume (PCV) Mean cell volume (MCV), mean cell haemoglobin (MCH) and mean cell haemoglobin concentration (MCHC) are reduced in iron deficiency anaemia. Smears shows anisocytosis, microcytosis, hypochromia and pencil cells. Red cell survival is significantly decreased to

45-85 days[9,10]). The bone marrow is normocellular with erythroid hyperplasia and absent iron stores[11]. Serum iron may be normal or reduced, TIBC is increased and transferrin saturation is low. Ferritin is a major iron storage protein in the body, and its reduced level is a more sensitive index of iron deficiency[12].

MATERIALS AND METHODS

Eighty five anaemic children with hypochromia and microcytosis were studied at the Department of Haematology, Shaikh Zayed Hospital, Lahore. 10 healthy subjects were included in this study as normal control. All the investigations were done in the Department of Haematology and Biochemistry, Shaikh Zayed Hospital, Lahore. Investigations performed were Hb, White Blood Cells Count (WBC), Erythrocyte sedimentation rate (ESR), Red Cell Count (RBC), Platelets count, Packed Cell Volume (PCV), Mean Cell Volume (MCV), Mean Cell Haemoglobin (MCH), Mean Cell Haemoglobin Concentration (MCHC), Red Cell Morphology, Differential Leucocyte Count (DLC), Serum Iron, Total Iron Binding Capacity (TIBC) and Serum Ferritin. Blood counts were performed on Sysmex K 1000. RBC morphology was performed on smears stained with Leishman's stain under microscope. Plasma iron and TIBC was measured colorimetrically. The method used for quantitative ferritin determination was a "one-step" immunoenzymatic assay based on the principle of the formation of a "sandwich" between the analyte to be detected and two specific monoclonal antibodies directed against different epitopes on the ferritin molecule. Computer software SPSS 8.0 was used for the analysis of data. One way ANOVA was used for analysis of group differences.

RESULTS

In this study 85 children were included with MCV less than 76 fl, MCHC less than 30 g/dl of red cells and blood film showing hypochromia and microcytosis. The patients were taken from Paediatric ward and out patients departments of Shaikh Zayed Hospital, Lahore. Ten normal individuals were included as control. Iron deficiency anaemia was considered to be present when: serum ferritin was less than 12 ng/ml[13] (Tables 1, 2, 3, 4).

DISCUSSION

Iron deficiency is wide spread throughout the world especially in developing countries[13,14]. It affects persons of all ages and economic groups. It is more common among the very young, among those on poor diets[15] and women of child bearing age,[16,17]. It is estimated that approximately two billion people experience adverse effects of iron deficiency[18]. It is considered a global health problem being more endemic in Asia and Africa as compared to north and western Europe. Anaemia tends to be more common in those who rarely eat meat[19]. Bellamy and Gedney (2000) observed functional iron deficiency in 35% admitted for critical illness[20]. Paracha et al (1997) demonstrated that iron deficiency was predominant cause of anaemia in children under 2 years of age[21]. Bessman and Feinstein (1979) observed iron deficiency in 62% of children with MCV <70 f[22]. In our study iron deficiency was present in 92% of patients. A study conducted by Marder et al. 1990, on 130 children, the iron deficiency was suggested by MCV <76 fl[23]. James et al. (1989), considered haemoglobin less than 10.5 g/dl and MCV < 75 fl as index of iron deficiency in children 1-4 years of age[24]. In this study MCV of iron deficient patients ranged from 51.2 - 75.8, mean 65.8 $\pm$ 6.29 fl/cell. The mean MCV in iron deficient subjects was significantly ($P<0.005$) lower than mean MCV of control subjects. Afroz et al (1998) used MCV/RBC count ratio to discriminate between iron deficiency and beta thalassaemia trait and ratio of >14% was marked as iron deficiency[25]. Bessman and McClure (1991) concluded that the iron status correlated poorly with any blood count parameter[26]. According to Beutler (1988) MCHC is reduced in iron deficiency[27]. Mills (1989) concluded that haemoglobin concentration and red cell variables (like MCV and MCHC) are not reliable means of identifying iron deficiency anaemia, but they are simple and can be easily measured in a community clinic[28].

Table 1: prevalence of iron deficiency.

Group	*Number*	*Age*	*Male*	*Female*
Total Patients	85 (100%)	4 months – 12 Years	60	25
Iron deficient	78 (92%)	4 months – 10 years	53	25
Non iron deficient*	07 (8.0%)	1 year – 12 years	07	00
Control	10	2 years - 12 years	08	02

*ß-Thalasaemia major (n=4), ß-Thalasaemia minor (n=3),

Table 2: Statistical values blood counts

Parameter	*Patient group*	*Range*	*Mean*	*Standard deviation (S.D)*	*Unit*
Hb	A (n=85)	3.7 – 10.7	7.29	1.64	g/dl
	B (n=78)	3.7 – 10.7	7.3	1.67	"
	C (n=10)	10.1 – 13.8	11.86	0.95	"
RBC count	A	1.80 – 5.83	4.13	0.81	X 10 ^{12}/l
	B	1.80 – 5.83	4.19	0.78	"
	C	3.88 – 4.92	4.5	0.39	"
PCV	A	12.6 – 36.1	26.68	4.89	l/l
	B	12.6 – 36.1	27.10	4.85	"
	C	33 - 40	37.5	2.4	"
MCV	A	51.2 – 75.9	65.8	6.68	fl/cell
	B	51.2 – 75.8	65.3	6.29	"
	C	75.5 – 88.8	81.8	3.92	"
MCH	A	12.3 – 22.5	17.8	2.9	pg/cell
	B	12.3 – 22.5	17.5	2.8	"
	C	23.7 – 28.8	26.32	1.9	"
MCHC	A	22.0 – 29.8	27.0	2.47	g/dl of RBC
	B	19.2 – 29.8	26.8	2.51	"
	C	30.0 – 33.7	31.6	1.05	"

A: Total patients (n=85), B: Iron deficient patients (n=78), C: Control (n=10)

Table 3. statistical values biochemistry.

Parameter	*Patient group*	*Range*	*Mean*	*Standard deviation (S.D)*	*Unit*
Serum Iron	A	17 - 108	40.93	16.81	ug/dl
	B	17 - 68	38.9	14.1	"
	C	69 - 115	82.2	13.4	"
TIBC	A	158 - 680	462	101	"
	B	300 - 680	480	83.2	"
	C	290 - 350	314	24.3	"
Serum Ferritin	A	0.5 - 350	21.8	58.45	ng/ml
	B	0.5 – 11.9	6.74	3.82	"
	C	22 – 240	98	76.28	"

A: Total patients, B: Iron deficient patients, C: Control

Table 4: Comparison of serum ferritin ng/ml.

	P value
Iron deficient and control	0.005
Iron deficient and non iron deficient.	0.004
Statistically significant	

In our study the MCHC of iron deficient patients ranged from 22.0-29.9 g/dl with a mean value of 26.8±2.51 g/dl of red cells.

Reinhart (1991) observed significant anisocytosis in iron deficient patients as compared to normal controls (P<0.005) [29]. In present study all iron deficient patients showed anisocytosis hypochromia and microcytosis and less number showed poikilocytosis.

Jacobs et al. (1972) observed serum iron 20.4±7.8 (10-36 ug/dl) in their iron deficient patients[30]. Lipschitz et al. (1974) observed in 32 patients with uncomplicated iron deficiency mean serum iron of 37±11 ug/dl and TIBC of 479±73 ug/dl[31]. Summers and Jacobs (1976), observed mean serum iron of 112 ug/dl, TIBC of 392 ug/dl in 24 normal subjects and serum iron 16.24 ug/dl and TIBC 487 ug/dl in 15 iron deficient patients[32].

In our study the serum iron of iron deficient patients ranged from 17-68 ug/dl with a mean value of 38.9±14.1 ug/dl and TIBC of 300-680 ug/dl with a mean value of 480±83.2 ug/dl. (Table .3). Simes et al. (1974) observed serum ferritin value of 1.5-9 ng/ml) in iron deficient subjects[33] . Lipschitz et al. (1974) reported in 32 patients, the mean serum ferritin 4 ng/ml with a range of 1-14 ng/ml[32]. Summers and Jacobs (1976)[33] reported mean serum ferritin of 90 ng/ml in 24 normal subjects and 7 ng/ml in 15 iron deficient patients. In present study the serum ferritin of iron deficient patients ranged from 0.5-11.9 ng/ml with a mean value of 6.74±3.82 ng/ml. Comparing the mean values of serum ferritin of iron deficient patients and control the difference is highly significant P = 0.005 and similarly the difference between iron deficient and non-iron deficient patients is also significant P = 0.004 Table No.4.

CONCLUSION

Iron deficiency was the commonest cause of hypochromia and microcytosis. No red cell parameters could be relied upon for the diagnosis of iron deficiency. Serum iron was low or normal in patients with iron deficiency anaemia. TIBC was raised or normal in patients with iron deficiency anaemia. The serum ferritin assay was the most sensitive and specific index for iron stores as compared to serum iron and TIBC.

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