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Haematological and biochemical parameter change in iron deficiency anaemia in children

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Abstract

Background: Iron deficiency Anaemia (IDA) is the most common cause of anaemia not only in Bangladesh but even worldwide. In iron deficiency anaemia several changes in haematological parameter have been reported. Therefore a relationship between iron metabolism and haematological change should be considered **Aim:** The aim of this study was to evaluate the haematological parameter change in children with IDA. **Materials and Methods:** This prospective study was conducted in TMSS medical college, Bogra, and Popular Diagnostic Centre Ltd., Bogra from April 2016 to April 2017 to determine the haematological parameter change in iron deficiency anaemia. Blood samples from 106 anaemic patients (58 male and 48 female.) and 50 controls were analyzed. Haematological parameters like Haemoglobin, MCV (mean corpuscular volume), MCH (mean corpuscular haemoglobin), MCHC (mean corpuscular haemoglobin concentration), RDW (red cell distribution width) platelet parameter (such as platelet count, platelet crit, mean platelet volume and platelet distribution width) were evaluated and other routine haemogram were studied. Biochemical parameters like serum iron, serum ferritin and total iron binding capacity were measured. **Results:** Out of 156 anaemic patients 106 had two biochemical parameters decreased and were diagnosed as iron deficiency anaemia. In IDA the mean haemoglobin, MCV, MCH, MCHC, was decreased and platelet count were increased and in some cases were decreased. The mean serum iron, mean serum ferritin were decreased and mean total iron binding capacity were increased. Significant correlation was observed between haemoglobin level with MCHC, platelet parameter serum iron, ferritin and total iron binding capacity. ANOVA (Analysis of variance) showed significant p value in IDA and control in all haematological parameters and three biochemical parameters. Analysis between IDA and anaemia with no biochemical parameters decreased showed significant difference in all the haematological and biochemical parameters. **Conclusion:** ANOVA showed significant statistical difference in all the haematological and biochemical parameters except TIBC between anaemic patients with decreased two of the three biochemical parameters and control. Analysis of variance test between iron deficiency anaemia and control subject with only one of three biochemical parameter decreased showed that this group does not have iron deficiency.

Key words: Hb%; MCV; MCH; MCHC; RDW; Iron; Ferritin; TIBC; Platelet count.

Introduction

Iron deficiency anaemia is the most common haematological disorder in the community.

As the name implies, iron deficiency anemia is due to insufficient iron. Without enough iron, human body cannot produce enough hemoglobin; as a result, iron deficiency anemia causes tiredness and short breath. Worldwide, the most important cause of iron deficiency anemia is parasitic infection

caused by hookworms, whipworms, and roundworms, in which intestinal bleeding caused by the worms may lead to undetected blood loss in the stool. These are especially important problems in growing children.¹ Malaria infections that destroy red blood cells (although the iron is recycled) and chronic blood loss caused by hookworms (where the iron is lost) contribute to anemia during pregnancy in most developing countries².

The principal cause of iron deficiency anemia in the developed countries is blood lost during menses in premenopausal women, which is not compensated by intake from food and supplements. Iron deficiency anaemia still remains the most common cause of anaemia not only in Bangladesh but also all over the world. According to the World Health Report, there are 1,788,600 people in this world suffering from iron deficiency anaemia. And iron deficiency anaemia is the foremost prevalent disease causing morbidity in the world ³. Many surveys had been conducted in Bangladesh to know the prevalence of iron deficiency. A study of 114 healthy, socioeconomically privileged girls demonstrated that 24% of this group had no storage iron of and 42% of girls had suboptimal iron stores ⁴. In a study of 85 men and 54 women in Finland, only traces of marrow iron were found in 4 to 7% of men, in 70% of women of 15 to 49 years of age, and in 23% of women of 50 years of age or older ⁵. In a survey of 1105 Canadians, iron stores, judged by serum ferritin values, were greatly reduced in about 25% of children, 30% of pregnant women, and 3% of men ⁶. In a study conducted by Looker AC ⁷, it was found that 9% of toddlers aged up to 2 years, 9% to 11% of adolescent girls, and women of child bearing age were found to be iron deficient. Of these, iron deficiency anaemia was found in 3% and 2% to 5%, respectively. Also 7% of men over 50 years of age and 1% of young men and teenage boys had iron deficiency ⁸. In Pakistan, anaemia was present in 47% of children and 30% of the adult females ⁹. Iron deficiency is particularly common in infants and pregnant women. The iron deficiency in women occurs most often during the reproductive years, whereas in men the incidence is relatively high in adolescent and low during young adulthood; it increases thereafter with advancing age.

In infancy, the occurrence of iron deficiency is equal in both sexes. It is usually detected between

the ages of 6 and 20 months; the peak incidence is at a younger age in infants born prematurely than in those born at term.

Materials and Methods

A cross sectional study was conducted from April 2016 to April 2017. A total of 156 subjects from 6 month to 15 years were included in this study. Blood samples were collected by venupuncture in EDTA anticoagulant tube. All haematological parameters were carried out by automated method. Adequate quality control measures were taken on each test procedure to ensure the reliability of results. Serum samples were collected in vacutainer after collection of whole blood, allow the blood by leaving it at room temperature. This usually took 15-30 minutes. The clot was removed by centrifuging.

Biochemical Examination on.

1. Serum iron.
2. Total iron binding capacity
3. Serum ferritin assay.

All biochemical examinations were done in automated biochemistry analyzer.

Haematological investigation complete blood count (CBC) was analyzer by 5 parts fully automated haematology analyzer. The cell counting components counts the number and types of different cells within blood such as haemoglobin, HCT, MCV, MCH, MCHC, RDW & platelet count. The results was printed out and or sent to a computer for review.

Results

106 patient's age between 6 month to 15 years and 50 control was enrolled in the study. Out of 106 patients 48 male and 58 was female. This study was conducted in TMSS Medical collage, Bogra, and Popular Diagnostic Centre Ltd., Bogra during the period April 2016 to May 2017.

Table 1: Age range of the patient (n=106) and control (n=50)

Age range	Frequency (control)	Percentage (%)	Frequency (patient)	Percentage (%)
6 month's- 2Year's	22	44	44	41.50
3 Year's - 6Year's	13	26	32	30.18
7 Year's - 10Year's	9	18	21	19.81
11 Year's - 15Year's	6	12	09	8.49
Grand Total	50	100%	106	100%

Table 2: Biochemical parameters of IDA and control.

Biochemical parameters	Control	Male	Female
Serum iron (g/dL)	70.35	21.65±1.03	19.62±1.01
Serum ferritin (ng/mL)	172.50	10.04±0.32	9.96±1.02
TIBC (g/dL)	306.22	399.62±1.02	401±2.02

Table 3: Percentage of TIBC (n= 106)

		Frequency	Percentage (%)
TIBC (g/dL)	>390	59	55.66
	274-385	47	44.34
Total		106	100

Table 4: Showing comparative hematological values for iron deficiency anemic males and females.

Parameters	Control		IDA	
	Male mean	Female mean	Male mean ± SD	Female mean ± SD
Hb (g/dL)	14.65	12.65	9.36±1.36	9.21±1.06
ESR (mm 1st hour)	8	9	38.06±23.10	36.61±24.48
RBC (M/ μ L)	4.9	4.05	4.05±0.69	4.22±0.43
PCV/haematocrit	46	40	27.63±2.65	29.17±3.13
MCV (fl)	84	80	65.39±6.02	65.05±4.06
MCH (pg)	29.50	27.20	23.01±1.73	23.63±2.49
MCHC (g/dL)	(con)	28.20	33.66±1.33	33.46±0.68
RDW(%)	10.53	10.53	12.73±2.88	12.11±2.20
MPV(fL)	8.80	8.70	7.09±0.63	8.06±0.62
Platelet (K/ μ L)	322.25	302.00	320.20±62.37	332.29±80.99
WBC (K/ μ L)	11.50	11.30	10.40±2.50	9.60±2.90
Neutrophil (%)	46.30	46.20	47.22±15.27	49.43±17.50
Lymphocytes (%)	28.20	27.20	44.53±14.67	43.23±17.10
Eosinophil (%)	1.04	1.02	2.75±2.70	2.32±1.50
Monocytes (%)	2	2.10	2.10±1.10	2.01±1.01

Table 5 : Percentage of platelet profile (n= 106)

		Frequency	Percentage (%)
Platelet Count (K/ μ L)	>400 K/ μ L	54	50.95
	150-400 K/ μ L	36	33.96
	<150 K/ μ L	16	15.09
Total		106	100

Laboratory investigation revealed that most common haematological abnormalities were decreased level of Hb%, MCV, MCH, and MCHC. RDW CV% increased followed by platelet count increased in 54% cases, normal 36% of cases and decreased in 16% cases. Among biochemical abnormality total iron binding capacity (TIBC) was increased and mean serum iron and ferritin was decreased.

Discussion

These observations were taken from patients of TMSS Medical College, Bogra and Popular Diagnosis Centre Ltd., Bogra. Moreover hookworm infestation is more common causes. These observations show that economically deprived and ignorant are mostly affected. In clinical manifestations, weight loss, decreases of appetite, diarrhea, attention problems, and weakness were the most common complaints of the patients with IDA. Also it is equally common complaints among the anaemic individuals who were not iron deficient. More ever, premature baby, pale skin color dyspepsia and headache, were other complaints almost equally common among and the patients with IDA. and the controls. These are symptoms of anaemia but not especially concered with IDA. These observations were similar with previous report of Ewood¹⁰. In our observation, the average MCV in IDA 65.05 fl. Smilarly the mean value of MCH was 23.63pg, mean value of MCHC was 33.46 g/dL and mean haemoglobin was 9.21 g/dL in

IDA. These observations was similar to the report by Bainton.¹¹ and Finach C.A. which showed mean MCV to be 74 fl, mean MCH to be 28% and mean haemoglobin to be 7.6 g/dL in patients with IDA¹².RDW CV(%) more than 15% which points more towards the microcytic nature of anaemia and more anisocytosis. Iron deficiency anaemia without other complicating disease could be screened out early by increased RDW when RBC indices were normal¹³ and Platelet count was normal in 36 % patients and thrombocytosis in 54% and thrombocytopenia 16% were detected. In the present study, mean serum iron on IDA was 19.62g/dL, which was significantly lower than control group70.35g/dL. In a study conducted in geriatric patients the mean was found to be 22.7 g/dL¹⁴ which is almost similar to our result. The principal limitation of the serum iron determination is variability in the values¹⁵, which may be due to both technical and physiologic factors¹⁶ such as contamination of glassware and reagents with iron although the use of disposable, plastic equipment has reduced such contamination considerably. Among the biochemical tests, total iron binding capacity (TIBC) was increased. 59% out of the IDA patients (48 male and 58 female).The mean value of TIBC in IDA was 401.02 μ g/dL, which was significantly higher than control group (306.22 μ g/dL). A study done in children IDA patients the mean TIBC was found to be 413.60 μ g/dL, which is also closer to our observation.

Though increased value of TIBC indicates iron deficiency, the normal or even lower value may occur in iron deficiency anaemia¹⁷. Statistical analysis was carried out using ($P < 0.05$); one-way ANOVA test was used for comparison of hematological parameters. ANOVA (analysis of variance) showed significant P value between mean platelet volume (MPV) in females (8.08fl) and males (7.59fl), ($P < 0.05$) in iron deficiency

anemia patients. ANOVA showed statistical significance in hematological and biochemical parameters between IDA and the control group and anaemia due to other diseases. It has also showed that the role of TIBC in diagnosing IDA cannot be over emphasized. ANOVA also showed that anaemia with decrease in any two of the three biochemical parameters might have iron deficiency while anaemia with decrease in one of the three biochemical parameters did not have iron deficiency.

Conclusion

Iron deficiency anaemia in children is still considered a major health problem all over the world. This is because of long term effects of mental and cognitive skills and on immunity and general physical wellbeing. Iron deficiency anaemia is most common anaemia and diagnosis is made by haematological parameter change and confirmed by decreases of all three biochemical parameters which is effective for therapeutic monitoring of iron deficiency anaemia.

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