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ORIGINAL ARTICLE

Prevalence of hematinics deficiency amongst female students and its correction

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Abstract

Background Nutritional anemia (NA) is common in India. While iron deficiency (ID) is a well recognized cause of NA, prevalence of deficiencies of other hematinics is not systematically investigated.

Setting Seventy students of a junior class of a polytechnic and 202 inmates of girl students home were taken up for study.

Methods Students were given a questionnaire to elicit anemia related symptoms. Blood was collected for complete blood count (CBC), serum ferritin, folic acid and vitamin B12. Students of polytechnic received hematinic at bed time during their menstrual periods whereas inmates of students home received hematinic at bed time, 3 days in a week. After 6 months blood tests were repeated in those who completed the treatment. CBC was done on Coulter counter and ferritin, folic acid and vitamin B12 were assayed by chemiluminescence. Students were divided into three groups- (1) *Control group* with Hb 12.0 g/dl or more and ferritin 15.0 ng/ml or more; (2) *ID Group* with Hb 12.0 g/dl or more and ferritin less than 15.0 ng/ml; and (3) *Iron Deficiency Anemia (IDA) group* with Hb less tha 12.0 g/dl and ferritin less than 15.0 ng/ml.

Statistics Basal parameters of three groups were compared using students t test. Change in parameters with treatment was compared using paired students t test.

Results Median age - 16 years (range 10 – 25). Anemia (Hb < 12.0 g/dl) - 94 (34.6%); MCV < 80 fl - 153 (56.3%); MCH < 27 pg - 167 (61.4%); Ferritin < 15.0 ng/ml - 161 (59.2%); Folic acid < 3.5 ng/ml - 34 (12.5%); Vitamin B12 < 258 pg/ml - 133 (48.9%) Pre-therapy: (1) Hb, MCV, MCH and ferritin significantly lower in ID and IDA Groups compared to control group. (2) Hb, MCV, MCH and Ferritin significantly lower in IDA Group as compared to ID Group.

Post-therapy (1) IDA group showed significant increase in Hb, MCV, MCH, ferritin, folic acid and vitamin B12. (2) final Hb (11.26+1.07) and ferritin (7.46+4.81) in IDA Group were subnormal. (3) MCV, MCH, ferritin, folic acid and vitamin B12 increased significantly in ID Group and control group**.**

Conclusions (1) Nutritional anemia is common amongst asymptomatic young female students. (2) Deficiencies of iron, folic acid and vitamin B12 are common and coexist. (3) 105 mg elemental iron for 3 days in a week for 6 months is not adequate to correct IDA. (4) 105 mg iron for 3 days in a week is enough to correct ID. (5) Non-anemic individuals with ID have iron deficient erythropoiesis. (6) Non-anemic individuals without ID, in this cohort, also had iron deficient eryhtropoiesis.

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Keywords Nutritional anemia · Iron deficiency · Iron deficiency anemia · B12 deficiency · Folic acid deficiency · Iron deficient erythropoiesis · Dose of elemental iron

Introduction

Nutritional anemia is common in India [1]. While high prevalence of iron deficiency has been well documented as the cause of nutritional anemia [2, 3], prevalence of deficiency of other hematinics has not been systematically investigated. Anemia is an end stage of hematinics deficiency. It is preceded by a stage of latent deficiency where serum level of hematinic (ferritin, folic acid, vitamin B12) is low with normal hemoglobin level. It was felt that malnutrition is likely to involve other hematinics besides iron. Hence, we decided to investigate apparently healthy students for anemia and hematinics deficiency.

Objectives

1. To find the prevalence of anemia and deficiency of hematinics amongst a group of apparently healthy female students.
2. To see if some anemia related symptoms can be used to identify subjects with anemia.
3. To assess the compliance and efficacy of two different dose schedule of hematinic treatment.
4. To assess the effect of treatment on various parameters (hemoglobin, MCV, MCH, serum ferritin, serum folic acid and serum B12) and anemia related symptoms.

Methods

Students of two institutions- (1) a junior class of ladies' Polytechnic, and (2) inmates of ladies boarding school- who were willing to participate were included in the study provided they had not taken any hematinics in past six months and did not have episode of acute infection in past four weeks. Participants completed a questionnaire (see Table 4 at the end) for assessing anemia related symptoms. Fasting blood sample was collected and at the same time students were given hematinic capsules (Hepatoglobin, Raptakoss) containing 105 mg elemental iron, 300 mcg folic acid and 10 mcg vitamin B12 to be taken at bed time- (1) for students of Polytechnic, during their menstrual periods, and (2) for inmates of boarding school, three days in a week (Monday, Wednesday and Friday). Medicines were distributed every month when inquiry was made about compliance and counter-checked by looking at the used strips of the medicines. Inquiry was also made about the side effects. At end of six months, participants were again given same questionnaire and blood was collected for CBC, serum ferritin, folic acid and vitamin B12. Arbitrary score was assigned according to response to questionnaire. CBC was done on Coulter Counter. Ferritin, folic acid and vitamin B12 were estimated by automated chemiluminescence system (Thyrocare Technologies Ltd, Mumbai).

Base line data of all students of both institutions was used to assess the prevalence of anemia and hematinic deficiency. Participants were divided into three groups according to their iron status: (1) control group with Hb 12.0 g/dl or more and serum ferritin 15.0 ng/ml or more; (2) iron deficiency (ID) group with Hb 12.0 g/dl or more and serum ferritin less than 15.0 ng/ml; and (3) iron deficiency anemia (IDA) group with Hb less than 12.0 g/dl and serum ferritin less than 15.0 ng/ml. Baseline values of various parameters in three groups were compared using student's t test; and changes in values of various parameters as a result of treatment were compared within each group using paired t test.

Results

Median age was 16 years (range 10–25). Prevalence of anemia and hematinic deficiencies is shown in table 1. 94 subjects of anemia include 77 with IDA, 10 with beta thalassemia trait (3 of them had iron deficiency as well) and 7 had anemia with normal ferritin (cause of anemia not investigated).

Table 2 shows the baseline data of three groups and comparison between three groups. Hb, MCV, MCH and ferritin were significantly lower in ID and IDA groups as compared to control group. All these parameters were significantly lower in IDA group compared to ID group. Serum vitamin B12 and folate levels in three groups were comparable.

Table 1 Prevalence of anemia and hematinic deficiencies in 272 subjects

Parameter	Hb (g/dl)	MCV (fl)	MCH (pg)	Ferritin (ng/ml)	Vit B12(pg/ml)[4]	Folate (ng/ml)
Subnormal Value	< 12.0	< 80.0	< 27.0	< 15.0	< 258.0	< 3.5
Subjects with Subnormal Value	94 (34.6%)	153 (56.3%)	167 (61.4%)	161 (59.2%)	133 (48.9%)	34 (12.5%)

Table 2 Baseline values of various parameters in 3 groups and their inter-comparison

Parameter Mean±S.D.	Control group*# n = 96	ID group*@ n = 81	IDA group#@ n = 77	Comparison of groups – p value		
				*	@	#
Hb (g/dl)	13.2±0.75	12.89±0.57	10.78±1.05	<0.01	<0.0001	<0.0001
MCV (fl)	83.1±4.87	79.37±4.03	72.54±6.99	<0.001	<0.0001	<0.0001
MCH (pg)	27.9±1.86	26.4 ±1.62	23.3 ±2.7	<0.001	<0.0001	<0.0001
Ferritin ng/ml	35.7±21.16	9.03±3.04	5.48±3.04	<0.0001	<0.0001 <0.0001	
VitB12 pg/ml	297.6±106.4	281.1±81.53	271.7±76.55	ns	ns	ns
Folate ng/ml	5.6±2.15	5.66±2.23	5.71±2.24	ns	ns	ns
Menses days	3.8±2.7	4.06±2.83	4.75±1.5	ns	ns	<0.01
Symptom score	4.1±2.5	4.7±2.9	4.2±2.6	ns	ns	ns

Table 3 Change in value of parameters with hematinic given for 6 months

Parameter Mean±S.D.	Control gr (n = 52)	ID group (n = 58)	IDA group (n = 43)
Hb (g/dl)	-0.24 ± 0.68	-0.12 ± 0.7	0.34 ± 0.82
p value	<0.02	ns	<0.01
MCV (fl)	3.4 ± 2.0	4.61 ± 2.29	4.53 ± 3.9
p value	<0.001	<0.001	<0.001
MCH (pg)	0.91 ± 0.62	1.55 ± 0.81	1.75 ± 1.68
p value	<0.001	<0.001	<0.001
Ferritin (ng/ml)	16.77 ±48.9	12.25 ± 15.88	2.13 ± 4.73
p value	=0.02	<0.01	<0.01
Vitamin B12 (pg/ml)	224.67 ± 124.93	189.83 ± 102.41	205.79 ± 83.3
p value	<0.001	<0.001	<0.001
Folic acid (ng/ml)	4.6 ± 5.98	3.88 ± 5.07	2.56 ± 4.41
p value	<0.001	<0.01	<0.01
Symptom score	0.9 ± 3.5	0.7 ± 3.1	1.1 ± 3.8
p value	ns	ns	ns

Compliance amongst students advised to take hematinics during their menstrual period was very poor. All the girls failed to take hematinics for 20-80% of the days during three months. Non-compliance was not due to side effects but forgetting to take medicine or being away from a place where the medicine was kept were the main reasons. Study was discontinued because of very high rate of non-compliance. Compliance amongst boarding school was very good (100%). There were no side effects. However, 37 students were transferred to boarding school in another town and therefore discontinued treatment.

For study at the end of six months 153 students were available. Change in various parameters as a result of hematinic given for 3 days in a week for a period of 6 months is shown in the Table 3. Hb increased significantly only in IDA group, while other parameters- MCV, MCH, ferritin,. vitamin B12 and folic acid increased significantly in all three groups. In ID group, final mean ferritin level was 21.27 ng/ml (SD 16.6); 105 mg elemental iron, three days/week for 6 months was effective in correcting ID. However in IDA group, final Hb (11.26+1.07) and ferritin (7.46+4.81) were still subnormal; 105 mg elemental iron, three days/week for six months was inadequate for treatment of IDA.

Discussion

IDA and ID were detected in 77 (28.3%) and 84 (30.9%) subjects respectively. Low vitamin B12 and folic acid levels were seen in 48.9% and 12.5% respectively. High prevalence of vitamin B12 and folic acid in patients with IDA has been reported earlier by us [5]. Several workers

Table 4 Questionare for assessing anemia related symptoms

Question	Response	Score for Yes
Do you feel tired during usual work?	Yes/No	1
Do you feel like resting in the middle of your work?	Yes/No	1
Do you feel drained out at the end of day's Work?	Yes/No	0.5
Do you feel sleepy during day?	Yes/No	1
Do you feel like sleepy while working?	Yes/No	2
Are you unable to concentrate while reading?	Yes/No	1
Are you unable to concentrate in lecture?	Yes/No	1
Are you unable to concentrate while watching T.V.?	Yes/No	1
Do you feel breathless on exertion/fast walking/climbing stairs?	Yes/No	2
Do you feel weak?	Yes/No	1
Do you get palpitations (feel your heart beating)?	Yes/No	1
Do you feel giddy?	Yes/No	2
Do you feel body ache?	Yes/No	1
Do you hear ringing noise in your ears?	Yes/No	1

have reported high prevalence of IDA amongst apparently healthy Indians [6–8]. Latent ID was slightly more common than overt IDA. Subjectswith latent ID are candidates to develop overt IDA over a period of time and should receive iron therapy to correct their ID to prevent or at least delay the development of IDA. 105 mg elemental iron given for 3 days/week for 6 months corrected ID in present study. However this regimen failed to correct IDA and hence IDA patients should receive oral iron daily for 6 months rather than 3 days/week. Fact that MCV and MCH increased significantly after iron therapy in control and ID group would imply that these groups also had iron deficient erythropoiesis. Although 15.0 ng/ml ferritin is taken as cut off level for diagnosis of ID, there are reports to suggest that even at higher ferritin levels, there is evidence of iron deficient erythropoiesis [9–11]. Our results corroborate this. As the cause of high prevalence of ID is malnutrition, it is not surprising that there is high prevalence of vitamin B12 and folic acid deficiencies as well in group that we studied. ID is known to affect gastric and jejunal function and that may also be an additional factor for high prevalence of other hematinic deficiencies along with ID.

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