

Yoga Enhances Bioavailability and Assimilation of Oral Iron in Young Female Patients of Iron Deficiency Anemia

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ABSTRACT

Introduction: Anaemia is one of most common ailment in women of developing countries. Most of dietary iron is not absorbed in gut so they get wasted. This study aims to search out the effect of selected yoga practices on bioavailability and assimilation of oral iron.

Material and Methods: 30 Young female patients divided in two groups with equal participants based on their interest in yoga practice. Case group received yoga practices along with standard treatment and control group received only standard treatment. Haemoglobin of both groups was recorded at time of diagnosis and during course of study (1st, 8th, 20th week of treatment).

Result: There was no significant difference in hemoglobin level between case and control group at start of study, 1st, 8th week of treatment. But there was significant difference in two groups at 20th week of study (P Value = 0.01). Case group had significantly higher level of hemoglobin as compared to control group at 20th week of study.

Conclusion: Yoga enhances baseline concentration of iron transporters in gut and increases the secretion of erythropoietin. Selected yoga practices can be used as preventive measure in vulnerable population as it enhances both absorption and assimilation of oral iron.

Keywords: Iron deficiency anaemia, Yoga, DMT1, Ferroportin

INTRODUCTION

Anemia is one of the most common ailments in developing countries, especially in women and preschool children.¹⁻³ Although cut off value slightly differs in different literatures but anemia is usually defined as hemoglobin level less than 13 g/dl for men and 12 g/dl for women.⁴⁻⁶ The most common type of anemia encountered in general practice is iron deficiency anemia (IDA) and it affect up to 10 % of world population.⁷ Nutritional deficiency of iron (pregnancy, lactation, poverty), intestinal malabsorption (excessive phytate or tannate in diet, atrophic gastritis), and blood loss (menorrhagia or GI bleeding, worm infestation) are common causes of iron deficiency anemia (IDA).⁵⁻⁸ Iron deficiency anemia commonly presents with weakness, pallor, palpitation, and irritability.^{6,7} Chronic IDA may present with koilonychias, angular cheilosis, and rarely with plummer-vinson syndrome. Peripheral blood smear shows microcytic hypochromic RBCs with decreased MCV, MCH, MCHC, and serum ferritin level while total iron binding capacity increases.⁵ Diagnosis of IDA can be made either by laboratory investigations or therapeutic response to iron therapy.⁶ IDA is treated by oral or parenteral iron supplementation. Oral route is preferred over the parenteral route.⁷ Oral iron therapy includes ferrous sulfate, while parenteral therapy with sodium ferric gluconate. Parenteral preparations are advised only if oral therapy is not tolerated or there is iron malabsorption.⁵⁻⁷ There is quick response to iron therapy with regression of symptoms

within a few days and reticulocytosis within 5 days. Hemoglobin rises within a week and gets its normal level within 6-8 weeks of treatment. Iron therapy should be continued for 3 months after normalization of hemoglobin level to replenish iron stores in the body.^{6,7}

Dietary iron is available in two forms; heme iron and nonheme iron and is mainly absorbed from duodenum.^{6,9} Only 1 – 5 % of nonheme iron and 10 to 20 % of heme iron is absorbed by duodenum and it is a small fraction of dietary iron available in diet.^{6,10} Heme iron is present in meat and nonheme iron is mainly found in vegetarian diet. Absorption mechanism slightly differs for these two types of dietary iron.^{10,11} Nonheme iron may be either in ferrous or ferric form. Ferrous form is easily absorbed but ferric form is difficult to absorb. Ferric form gets converted to ferrous form by ferric reductase Dcytb, expressed on apical side of duodenal enterocytes. DMT1 present on apical side of duodenal enterocyte cotransports iron and hydrogen ion inside the cell. After entering the enterocyte ferrous form of iron binds with mobilferrin and gets transported to basolateral side. Ferroportin transports iron across basolateral membrane. Inside interstitial space ferrous form get oxidized into ferric form by ferroxidase and combines with transferrin for transport in blood. Heme iron is transported across apical membrane by some brush border protein or endocytosis. Internalized heme iron breaks down into ferric form of iron, CO, and biliverdin. Then ferric iron is reduced in ferrous iron and rest of mechanism follows same as that of non heme iron.¹⁰

Primary goal of this study was to find out that does selected yogic practices has any impact over iron metabolism. A positive result in the study may give us a lead towards finding a preventive measure of IDA in high risk population.

MATERIAL AND METHODS

This study was conducted at UPRIMS&R (Medical College) between January and July 2014. Patients of iron deficiency anemia visiting Medicine OPD were recruited in the study as per following inclusion and exclusion criterion.

Inclusion criterion

01. Female patients between 20 to 30 years of age

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- 02. Hemoglobin level > 7 gm/dl and < 12 gm/dl
- 03. Microcytic hypochromic blood picture
- 04. History suggesting of IDA
- 05. Lactovegetarian

Exclusion criterion

- 01. Identifiable source of blood loss (Menorrhagia, Peptic ulcer disease)
- 02. Parasitic infestation
- 03. Any concurrent disease capable of causing anemia of chronic disease
- 04. History of colorectal cancer in family, obstructed labor, myocardial infarction, CAD, arrhythmia, diabetes mellitus, spinal cord diseases, hemorrhoids, hernia, abdominal surgery
- 05. Pregnancy

30 Female patients qualifying mentioned criterion and consenting on paper were recruited in the study. Purpose and procedure of study was explained to all participants and they were equally divided in two groups based on their interest towards yoga. All participants were diagnosed as IDA based on hemoglobin level, hypochromic microcytic blood picture, and history suggestive of IDA. Case group (N=15) was offered selected yoga in addition to standard treatment. Control group (N=15) was given standard treatment only. Standard treatment of IDA included ferrous sulphate 325 mg TDS empty stomach and was advised to take a glass of milk daily. 25 minutes of yogic practices included pawanmuktasana, mandukasana, bhastrika, kapalbhati, mahabandh; 5 minutes each. Hemoglobin level at time of diagnosis was recorded. Participants of both groups were advised to follow up at 1st, 8th, and 20th week of starting the treatment. Improvement in hemoglobin level was used as indicator of successful treatment in both groups.

STATISTICAL ANALYSIS

Data was obtained as mean ± SD of hemoglobin level in gm/dl in both case and control groups. Obtained data of case and

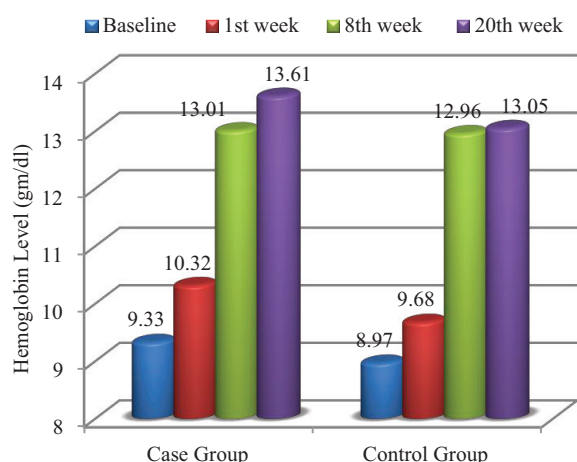


Figure-1: Change in hemoglobin level during course of study

control groups were compared side by side at each point of time using unpaired t-test and this analysis was done using SPSS V-20. P value < 0.05 was considered statistically significant. Table was prepared using Microsoft office 2010 and figures by GraphPad Prism 6.

RESULTS

Table-01 and figure-01 summarize the baseline hemoglobin level as well as changes at different point of study. Pattern of change in hemoglobin level in both groups during course of study can be better appreciated by figure-02. Hemoglobin level in case and control groups at baseline were 9.33 ± 1.11 gm/dl and 8.97 ± 1.15 gm/dl respectively; observed difference between two data was not significant (P Value = 0.39). At the end of 1st week of treatment, on comparing hemoglobin levels in case (10.32 ± 0.92 gm/dl) and control group (9.68 ± 1.01 gm/dl), p value came to be 0.08. So there was again no significant difference between two groups. Similarly at the end of 8th week of treatment hemoglobin level in case (13.01 ± 0.64 gm/dl) and control group (12.96 ± 0.72 gm/dl) shows no significant difference (P Value = 0.83). But at the end of 20th week of treatment there was significant difference (P Value = 0.01) between hemoglobin levels of case (13.61 ± 0.62 gm/dl) and control group (13.05 ± 0.60 gm/dl).

DISCUSSION

There are only limited numbers of studies finding the effect of yogic practices in anemia. Although available studies are not specific for iron deficiency anemia yet they all shows positive result and favor the findings of present study.¹²⁻¹⁴ Yogic practices like pawanmuktasana, mandukasana, kapalbhati, and mahabandh massages the abdominal viscera. There is squeezing of abdominal viscera followed by release of pressure. These yogic practices changes the blood flow through abdominal viscera in alternating pattern; decreasing with squeezing and increasing with release of pressure. Thus abdominal viscera face hypoxia followed by increased blood flow. Mahabandh and bhastrika (with antar and bahir kumbhak) involve active breath holding and thereby creates generalized hypoxia like condition.¹⁵⁻¹⁷

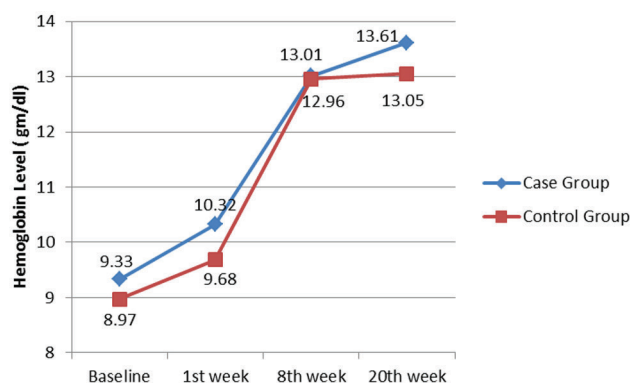


Figure-2: Pattern of change in hemoglobin level during course of study

SN.	Time of measurement	Case Group (Hb = gm/ dl)	Control Group (Hb = gm/ dl)	P value
1	Base line	9.33 ± 1.11	8.97 ± 1.15	0.39
2	End of 1 week	10.32 ± 0.92	9.68 ± 1.01	0.08
3	End of 8 week	13.01 ± 0.64	12.96 ± 0.72	0.83
4	End of 20 week	13.61 ± 0.62	13.05 ± 0.60	0.01

Table-1: Significance of changes in hemoglobin level during course of study

Effective erythropoiesis requires building blocks (like iron etc) and erythropoietin.¹⁸ Amount of dietary iron to be absorbed depends on baseline concentration of DMT1 and ferroportin receptors on surface of enterocytes.¹⁰ Concentrations of these receptors are mainly regulated by hepcidin, availability of dietary iron, and need of body. Hepcidin is produced by liver and it decreases the absorption of iron. Hepcidin production is decreased by hypoxia and increased by iron and inflammation.⁷ Erythropoietin is glycoprotein primarily secreted by kidney and liver in response to tissue hypoxia and increases the process of erythropoiesis in bone marrow.¹⁸

Anemia causes hypoxia within body. So there in anemia hepcidin level will be lower and erythropoietin will be higher. With oral iron therapy hemoglobin level raises thus hypoxia decreases. So hepcidin level will increase and erythropoietin level will decrease with treatment. As a result of induced hypoxia by these yogic practices within case group hepcidin level may not/ only slightly increase and there by concentration of DMT1 and ferroportin level stays high. Similarly erythropoietin may not/ only slightly decrease and thus increasing the assimilation of absorbed iron. So equilibrium between hepcidin and erythropoietin stays towards higher hemoglobin level. Thus it is clear with above discussion that significant difference observed at end of study was possibly as a result of ability of selected yogic practices to induce hypoxia within body (mimicking the anemia).^{10,18}

Strength - Present study included only young female patients, so benefit can be predicted with better confidence in given population. Inclusion and exclusion criterion was strict enough to diagnose all participants as nutritional IDA, so that underlying physiology can be assumed to be similar. Inclusion of only lactovegetarian in study strictly emphasizes the role of DMT1 and ferroportin transporters in study.

Limitations - Only females were included in study and they were not followed up after stopping the treatment. Size of sample was small and population of only western UP was included in study.

Future recommendations - This study should be conducted with bigger sample size, including male patients. More hematological and biochemical markers should be included in the study so that underlying mechanism behind positive effect of yoga in IDA can be explored out with more quantitative values.

CONCLUSION

Selected yogic practices are easy and effective way of increasing the bioavailability of dietary iron. As women in developing countries are at higher risk of IDA, so it will be very helpful, if we prescribe these yogic practices along with pharmacotherapy. Continuing the same as daily habit may be tried as an excellent preventive measure in vulnerable population.

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