

CORRECTION OF ANEMIA AND IRON DEFICIENCY IN VEGETARIANS BY ADMINISTRATION OF ASCORBIC ACID

DINESH C. SHARMA* AND RATI MATHUR

Department of Biochemistry,
S M S Medical College,
Jaipur - 302 004

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Abstract: Twenty-eight strict vegetarians were given 500 mg ascorbic acid twice daily after lunch and dinner for two months. Hemoglobin and certain iron status parameters were measured before and after the treatment. Ascorbate treatment increased mean hemoglobin by 8%, serum iron by 17% and transferrin saturation by 23% and decreased total iron binding capacity by 7%. All these changes were statistically significant. The rise in serum ferritin was 12%. The serum protein or copper level did not indicate their dietary deficiency, while initial serum ascorbate level were low which rose by 60% on therapy. It is concluded that ascorbate supplementation is a better method of improving hematologic and iron status than iron salt administration.

Key words : ascorbic acid iron deficiency anemia
vegetarians hemoglobin iron ferritin

INTRODUCTION

Anemia is the second most common affliction in the world and iron deficiency is the most common cause of it (1). The incidence of iron deficiency anemia is much greater in India than western countries, despite the fact that daily iron intake of Indians is twice that of westerners (2, 3). This apparent paradox is attributed to consumption of predominantly cereal based diet, rich in phytate, oxalates, phosphates, fiber and other inhibitors of iron absorption, by the majority of Indians who practice vegetarianism on account of religion or poverty (4, 5). So we had found significantly lower serum iron in healthy vegetarians as compared to healthy non-vegetarians (6). Similarly vegetarian parturient women had significantly lower hemoglobin, serum iron and transferrin saturation in comparison to their non-vegetarian counterparts (7). Recently in a closely matched study all the parameters (hemoglobin, serum iron, transferrin saturation and ferritin) were significantly lower in vegetarian women and

their newborns, respectively, despite having received supplemental iron (Ferrous sulphate=60 mg Fe) for about six months during antenatal period (5). The absence of expected response in hemoglobin regeneration was perhaps due to the fact the vegetarian diet was not deficient in iron but some other nutrient. The dietary survey of vegetarian mothers revealed that their diet was lacking in ascorbic acid as the consumption of fruits and citrus fruits was meagre (5).

The present study was, therefore, undertaken to see the effect of administration of ascorbic acid on hemoglobin and iron status of strictly vegetarian people.

METHODS

The subjects of this study were taken from the staff of the Department of Biochemistry, medical and nursing students, neighbours etc. who volunteered for the study and were vegetarians. All person were known to be healthy so that the drug compliance could be checked frequently and follow up was easy. They were

*Corresponding Author

selected on the basis of their dietary habit (vegetarianism) rather than initial hemoglobin level. All the subjects were free from infection and inflammation which are known to affect serum iron, total iron binding capacity and ferritin values (3).

The study started with 36 persons but ended with 28; eight persons discontinued vitamin tablets or were erratic in taking them. All the subjects were asked to take a 500 mg ascorbic acid tablet (Celin, Glaxo) within half an hour after lunch and dinner regularly for two months. Thus each person received 1 gm ascorbic acid daily and a total of 60 gm during the study. The dose was not large enough to cause any harmful effect. No one had complained of any side effect. The subjects were not allowed to take any hematinic during this study.

The blood was collected before and after the drug trial. The following estimations were performed on both the samples immediately after the collection - blood hemoglobin (Hb) (cyanmethemoglobin method), serum iron (8), total iron binding capacity (TIBC) (8), percent saturation (PS), (by calculation), serum ferritin (9), serum copper (10), total proteins (11) and ascorbic acid (12).

An oral questionnaire method was used to find out the details of the diet intake and dietary habits of all the subjects studied.

The results were statistically analysed by the paired 't' test (13). The critical level of significance was 5 percent (probability, 0.05).

RESULTS

Out of 28 subjects of this study, 10 were male, 18 were female, and 23 had initial Hb level below the WHO normal range. Their age ranged between 18-50 years. All were vegetarians and had regularly taken vitamin C tablets. This is confirmed by a rise in ascorbic acid of about 60% in two months time (Table I)

The pre-and post-treatment values are shown in Table I. There was a statistically significant rise in blood hemoglobin, highly significant rise in serum iron and a significant fall in total iron binding capacity. The rise in transferrin saturation of plasma was highly significant. Interestingly, the response to therapy was better in those who were iron deficient/anemic. Serum ferritin level also showed a rise but statistically insignificant. It may be because (i) the normal range of serum ferritin is very wide, (ii) increased iron was preferentially utilized for hemoglobin regeneration rather than storage, and (iii) ferritin reflects storage iron which was not expected to rise appreciably in such a short time.

TABLE I : Hematologic and iron status of vegetarians before and after ascorbate treatment.

Parameter	Pre-treatment level	Post-treatment level	"t" (paired)	"P"	Percent rise
Hemoglobin (g/dl)	10.10 ± 01.80	10.90 ± 01.40	5.81	<0.001	07.90
Iron (µg/dl)	63.70 ± 13.70	74.50 ± 13.00	6.36	<0.001	16.90
Total Iron Binding Capacity (µg/dl)	325.30 ± 49.60	301.70 ± 55.40	-3.62	< 0.010	-07.20
Percent Saturation (%)	19.90 ± 05.40	24.40 ± 04.90	4.32	< 0.001	22.60
Ferritin (ng/ml)	39.90 ± 39.30	44.70 ± 40.80	1.23	NS	12.00
Ascorbic Acid (mg/dl)	00.47 ± 00.10	00.75 ± 00.20	7.03	<0.001	59.50
Total Proteins (g/dl)	06.33 ± 00.47	06.42 ± 00.43	0.09	NS	01.40
Copper (µg/dl)	80.90 ± 18.00	81.40 ± 19.30	0.53	NS	00.60

All values are Mean ± SD; NS-Indicates Not Significant

DISCUSSION

The improvement in iron status and correction of anemia in vegetarians by giving only ascorbic acid is a very important finding. Such studies were also conducted in the past but the results were not conclusive (14), because the studies were multifactorial (14).

The role of ascorbic acid in iron metabolism is manifold. It reduces ferric iron to ferrous form which is then absorbed, lowers the pH which is conducive to iron absorption, reverses the inhibitory effect of phytate, oxalate, phosphate etc., and also forms chelate with iron for absorption (15).

As dietary proteins and copper also affect iron absorption and utilization, so in this study total serum proteins and serum copper were also estimated. Their levels were within normal range (16) suggesting nutritional adequacy of these nutrients. On the other hand ascorbate level in serum was low or on the lower side of normal (16) indicating inadequate vitamin C nutrition. This confirms our contention of Vitamin C nutritional inadequacy in vegetarian population on account of meagre intake of fruits, especially citrus fruits (5). The intake of fruits by subjects of present study was also very low, as revealed by diet survey during oral questionnaire.

The control of nutritional anemia is one of the national health programme of Government of India (17) and pregnant women are advised

to take ferrous sulphate tablets. As iron preparations did not give desired response in our previous study (5) and are not well tolerated by many persons we instead suggest vitamin C tablets (500 mg) to be given twice daily after every major meal. This will improve iron status and correct anemia as shown in this study. In contrast to iron preparations ascorbic acid is well tolerated, quite palatable and harmless. The risk of forming oxalate stones was reported with only megadoses of vitamin C (18), and even this was not confirmed in experimental animals (19). In addition, the daily consumption of vitamin C may confer following benefits (20) - prevent common cold and other viral infections, retard atherosclerosis, decrease risk of cancer, slow down ageing and reduce toxicity of metals.

It is hoped that this study will stimulate further work in this field and that physicians will see the need for prescribing vitamin 'C' tablets instead of iron tablets for amelioration of anemia or iron deficiency, especially because men and women need to absorb only 1.14 to 2.38 mg of iron per day (21) while the actual intake from vegetarian diet in this region is calculated to range from 22.0 to 37.0 mg per day (22).

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