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Original Article

Serum and Urine Level of Zinc in Patients with Minor Beta Thalassemic in Ali-asghar Hospital During the Years 2005-2006

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ABSTRACT

Introduction and Objective: Zinc as the second trace element of the human body plays an important role in numerous functions. A large number of research studies have showed serum zinc deficiency and excess urinary excretion in patients with major beta thalassemia, but few studies revealed excess urinary zinc excretion in minor beta thalassemia and no study investigated serum zinc levels in this group. This study aimed to measure serum and urine zinc level in patients with minor beta thalassemia.

Materials and Methods: The study was observational and cross-sectional. Blood and 24-hour urine samples were collected from carriers of beta thalassemia who attended Ali Asghar Hospital for blood transfusions for their children. They had documented hemoglobin electrophoresis for their status. The serum and urine zinc levels were measured by atomic absorption spectrophotometer. Student's t test was used for comparison of groups.

Results: The average level of zinc in the serum and urine of the male cases was 69 ± 10 µg/dl and 714 ± 162 µg/dl and in the female cases was 58 ± 11 µg/dl and 751 ± 162 µg/dl respectively and was 64 ± 12 µg/dl and 730 ± 120 µg/dl totally. The obtained serum zinc was lower and the urine zinc was higher in minor beta thalassemic persons than the amounts mentioned by references for the subjects of the same sex and age. The serum zinc level of anemic patients with minor beta thalassemia was lower (63 ± 11 vs 72 ± 13 µg/dl) and the urine zinc level was higher (792 ± 183 vs 673 ± 202 µg/dl) than non-anemic patients.

Conclusion: Minor beta thalassemics have lower serum zinc level and due to abundant roles of zinc can make benefit from zinc supplementation. This decrement may be attributed to tubulopathy in these patients.

Key words: Minor thalassemia, Zinc, Urine, Serum

Introduction

Zinc, following iron is the second trace element of the human body and plays an important role in the metabolism of proteins and nucleic acids as well as stabilizing cell membrane. It is also a cofactor for more than one hundred crucial biologic enzymes (1). It has been proved that zinc is essential and involved in many physiological activities, including immune function, taste sensation, dark adaptation, wound healing, fat metabolism, sexual function, and nervous system (1,2).

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The total amount of zinc in the body is 1.4-2.4 g. Serum zinc level in a normal person is 12-20 nmol/l or 80-130 µg/dl in universal references. Nutritional lack of zinc is seen in many developing countries and various diseases (3).

Since 1968, a large number of research studies have been conducted to study zinc deficiency in patients with major beta thalassemia. Although most of these researches revealed decreased levels of serum zinc in beta thalassemic patients (4), but two of the studies indicated that serum zinc levels were normal or higher (5,6). The amount of urine zinc in beta thalassemic patients was above the normal level due to chronic hemolysis which results in zinc excretion in urine (7). A study carried out by Dr Larijani et al in Iran showed that zinc level in 79% 0f major beta thalassemic patients was lower than the control group (8).

Various causes have been suggested to explain the reason of zinc deficiency in thalassemic patients including prolonged hemolysis (8) resulting in zinc excretion in urine, using deferoxamine (9) and renal tubulopathy (9). Zinc deficiency in major beta thalassemic patients leads to decreased immunity (10), delayed puberty, and growth retardation (11). Nevertheless, it has been proved that zinc treatment has some effects on the level of somatomedin C (12), linear growth (11), and function of lymphocytes (13). In addition, it has been reported that serum zinc level in patients with intermediate beta thalassemia is low (14).

Unfortunately, few studies have been done on minor beta thalassemic cases. A study conducted by Turker et al showed that the amounts of zinc in the 24-hour urine samples of carriers of beta thalassemia were larger than the amounts reported by references, which was associated with renal tubulopathy (15). Another study and also a case report mentioned renal tubulopathy in minor beta thalassemic persons (16-17).

Since few studies have measured zinc level in minor beta thalassemia and considering that a large population of Iranians, especially those who settle in north provinces, carries the gene for beta thalassemia, the present study aimed to measure zinc levels in urine and serum of these cases. Also, the surum and urine zinc are measured with respect to sex and hemoglobin. Hemoglobin levels below 14 and 12 were considered anemia for male and female cases respectively. It seems that due to the significant number of existing carriers, the important role of this element, i.e. zinc, in different functions of the human body and the availability of zinc for treatment purposes, the results of this investigation will be of great importance.

Materials and Methods

This study was observational and cross-sectional. In this regard, 57 subjects were selected from the parents of children who were diagnosed as major beta thalassemia and referred to Ali-Asghar Hospital for blood transfusion. Hemoglobin electrophoresis of these parents had revealed that they were carriers of beta thalassemia. All the parents of beta thalassemic patients who attended Ali Asghar hospital and were not acutely ill, had no history of allergic disease or drug history including zinc sulfate or oral contraceptive pills and were not pregnant (for women) were included in the study. After informing the subjects of the plan and taking their consents, the blood specimens were taken. In this respect, 1-2 cc of blood was poured into the glass tubes containing EDTA and 2-3 cc into the plastic tubes washed by nitric acid, using an acid-washed sampler tip. Blood cells and RBC indices were measured by Sysmex KX21. The sera of the samples in acid-washed tubes were centrifuged immediately after coagulation (at most 45 minutes). Also, the 24-hour urine samples were collected in acid-washed plastic containers.

As the amount of zinc in red blood cells is 8 times as much as that in serum, we cautioned that the blood specimens were not lyzed. For this reason, 7 of the initial 57 cases were excluded from the study. Meanwhile, 50 cc of the 24-hour urine sample was shaken well and put in the acid-washed tubes. The prepared specimens were immediately transferred to the "Cellular and Molecular Research Institute" of Iran University of Medical sciences and were kept at a temperature of -80̊ c for at most 6 months before examination.

Blood and urine zinc levels were measured by atomic absorption spectrophotometer (Unicam 929, Philips Company, UK). Atomic absorption spectrophotometer is an optimal choice to measure the amount of zinc in serum or other biologic fluids of the body owing to its high sensitivity and specificity. Serum samples were diluted as 1:3 and urine samples as 1:4. Each specimen was given to spectrophotometer in duplicate and the means of obtained results were recorded. Zinc levels in serum and 24-hour urine samples were measured and compared with references.

For statistical analysis, student's t test was used for comparison of subgroups. Significant level was considered as less than 0.05.

Results

The age range and the mean age of the 50 minor beta thalassemic cases included in the study were 23 to 49

and 32 years respectively. Females and males constituted 24 (48%) and 26 (52%) of this population respectively. Meanwhile, 33 (66%) of the studied cases suffered from anemia, while 17 (34%) were not anemic. The average level of zinc in serum and urine was found to be 64 ± 12 µg/dl and 730 ± 120 µg/dl (Figure 1). The average level of zinc in the serum and urine of the male cases was 69 ± 10 µg/dl and 714 ± 162 µg/dl and in the female cases 58 ± 11 µg/dl and 751 ± 162 µg/dl respectively (Figure 2). The level of zinc excretion in the anemic subjects was higher than that in non-anemic ones and the difference was statistically significant (p = 0.01) (Table 1). In addition, the level of zinc in the anemic subjects was lower than that in non-anemic ones and the difference was statistically significant (p = 0.03) (Table 1).

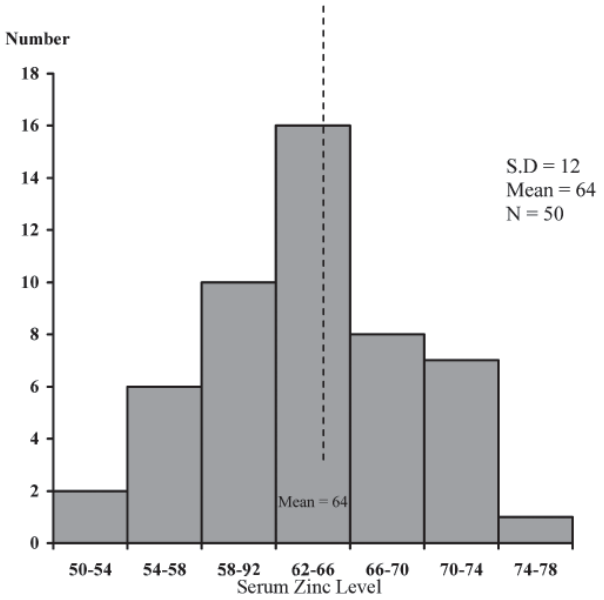

Figure 1. Histogram of serum zinc in minor beta thalassemic patients

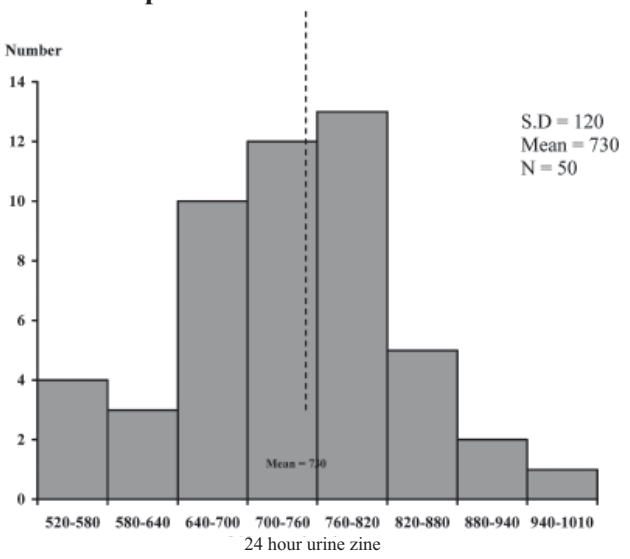

Figure 1. Histogram of urine zinc in minor beta thalassemic patients

Table 1. Serum and 24 hour urine zinc of anemic and non-anemic carriers of beta thalassemia

Minor beta thalassemics	Serum zinc level (µg/dl)	24 hour urine zinc(µg/dl)
Anemic patients	63 ± 11	792 ± 183
Non-anemic patients	72 ± 13	673 ± 202

Discussion

Tubulopathy and excess zinc excretion in minor beta thalassemia have been mentioned in previous studies. We investigated whether this excess excretion really exists and if it could cause zinc deficiency in this population (15-17). We measured serum and urine zinc simultaneously in minor beta thalassemic persons to evaluate probable benefit of supplementation of this essential micronutrient in their diet.

Although there are no definite diagnostic criteria of zinc deficiency, serum and plasma zinc measurement is a very valuable tool for diagnosing individuals at high risk of mild zinc deficiency by determining exchangeable body stores of zinc. The amount of this trace element in urine depends on diet. In addition, external contamination of urine with metals occurs more with urine samples than with blood collections(1).

The obtained serum zinc levels in minor beta thalassemic persons were lower than the amounts mentioned by references for the subjects of the same sex and age. According to a research which was performed by Dr Hashemi et al on healthy adult Iranian population at Cellular ad Molecular Research Institute of Iran University of Medical Sciences (18), the average concentration of zinc in serum was 75 ± 15 µg/dl. Serum zinc was 76 ± 15 µg/dl and 73 ± 16 µg/dl in men and women respectively using atomic absorption spectrophotometer (Unicam 929, England). Our results revealed that serum zinc level of minor beta thalassemic persons (64 ± 12 µg/dl) and also male (69 ± 10 µg/dl) and female subgroups (58 ± 11 µg/dl) are lower than healthy people. Up to our knowledge and performing searches in English literature, serum zinc level in carriers of minor beta thalassemia has not yet been investigated. No previous study has measured urine zinc level in healthy Iranian population. According to a study performed by Turker et al, the average urine zinc in healthy persons of the age-matched population with our study was 314

± 135 µg/dl. In the latter study, the average urine zinc for minor beta thalssemic persons were 988 ± 262 µg/dl and 734 ± 198 µg/dl in anemic and non-anemic minor beta thalassemic persons respectively. Urine zinc level of carriers of beta thalassemia in our study was higher in comparison with healthy subjects of the same age in the study of Turker. Our results showing excessive excretion of zinc correspond with the outcomes of the study carried out by Turker et al and two other studies (15-17).

Serum zinc levels in females and males showed no statistically significant difference, although serum zinc level was higher in males. These results are consistent with the study of Hashemi et al and Siller et al (18,19), though both of these studies were performed on healthy persons. Moreover, the level of zinc in the anemic subjects was lower than that in non-anemic ones and the difference was statistically significant. This result is consistent with results of Turker (5).

Females and males showed no statistically significant difference in terms of urine zinc levels, though the urine zinc excretion was higher in females. Unfortunately, the urine zinc level of male and female carriers of beta thalassemia has not been mentioned with regard to sex in the study of Turker (15). The level of zinc excretion in the anemic subjects was higher than that in non-anemic ones and the difference was statistically significant. These outcomes are compatible with the study of Turker (15).

Due to the results of study of Turker and our results, carriers of beta thalassemia have lower serum zinc levels and excess excretion of zinc in urine. Currently it has been stated that the only way of diagnosing mild and moderate zinc deficiency is by administrating zinc supplements and observing the clinical improvements in the health status as an increase in their height, weight, and head circumference (18).

Zinc supplementation can reverse thymic involution, increase serum thymulin level, restore the impaired immune function, and improve T cell response. Decreased interferon alpha level responded adequately to zinc supplementation. It has also been proved that infections, especially viral respiratory infections respond favorably to oral zinc sulfate and the clinical duration of common cold is markedly reduced. The entry of viruses into the cells is prevented by improvement of the cellular membrane stability (20).

Conclusion

By reviewing the obtained data, the authors suggest that by measuring serum and urine zinc in minor beta thalassemic persons and use of zinc supplementation for those who have low levels of serum zinc or excess urine zinc excretion, the long term complications of zinc deficiency in this population can be controlled. As only few previous studies had investigated the zinc excretion in minor beta thalassemic persons and there is no other study concerning serum zinc level in this group, more extensive and comprehensive researches are necessary for confirmation or rejection of our results.

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