



Original Article

Relationship Between Zinc and Anaemia in Chronic Haemodialysis Patients

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Abstract

End stage renal disease (ESRD) patients receiving haemodialysis (HD) are frequently associated with anaemia. Zinc, being an important nutrient for haemoglobin synthesis, was studied for its effect, if any, on renal disease associated anaemia among patients in the HD unit of BSMMU (formerly JGMR), Dhaka. Surprisingly, a low plasma zinc level and a high corpuscular (RBC) zinc level was observed. All of our subjects were found anaemic. A significant correlation was observed between plasma zinc level on one hand and haemoglobin level as well as RBC counts on the other hand. There are several suggestions for this low plasma and high corpuscular zinc level. However, this altered zinc level in plasma and red blood corpuscles might interfere with haemoglobin synthesis and might be one of the factors for renal disease associated anaemia.

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Introduction

Zinc is an essential trace element. Zinc, together with other trace metals, has a role in haemoglobin synthesis. Zinc deficiency has been found to be associated with anaemia, increased erythrocyte fragility, Pernicious anaemia as well as some other bodily functional abnormalities.^{1,2,3} ESRD patients receiving maintenance HD are frequently associated with anaemia.^{4,5,6}

Zinc plays an important role in haemoglobin synthesis by activating delta-aminolaevulinic acid (ALA) dehydrogenase, an enzyme essential for the formation of porphobilinogen from two ALA molecules. A study reported presence of anaemia in haemodialysed patients and suggested that this could be due to increased corpuscular zinc level resulting in disturbed haem synthesis.⁷

Subnormal plasma zinc levels have been reported in dialyzed and non dialyzed uraemic patients indicating that zinc metabolism in abnormal in uremia.^{4,5,8,9,10} In chronic haemodialysed patients low serum & high corpuscular zinc levels are reported and proposed to be the cause of anaemia.^{5,12,15} Increased corpuscular zinc level in chronic HD patients might represent an abnormal shift of serum zinc into erythrocytes or ineffective erythropoiesis are associated with a decreased rate of cell division and maturation leading to anaemia.⁴

Materials and methods

Fifteen ESRD patients of either sex, ages ranging from 35 to 60 years and undergoing maintenance HD twice weekly for more than six months were selected for the study. Patients were under

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treatment in the HD unit of the department of Nephrology, BSMMU (formerly IPGMR), Dhaka. 5 ml of fasting blood was obtained from the subjects. Estimation of zinc concentration in plasma and RBC were carried out directly by Atomic Absorption Spectrophotometry (AAS) in the laboratory of the chemistry division of Bangladesh Atomic Energy Commission, Ramna, Dhaka.

Atomic Absorption Spectrophotometer Model: Perkin Eelmer- 560 was used. Haemoglobin concentration, Haematocrit Value and RBC count were measured in the Department of Physiology, BSMMU (IPGMR), Dhaka. Haemoglobin concentration was done by Sahli's method, Haematocrit Value by Wintrobe's method and total count of RBC using Neubauer's counting chamber.

Results

Zinc level in plasma and erythrocytes in our subjects were 68.7 ± 6.2 $\mu\text{g/dl}$ and 1510.9 ± 93.9 $\mu\text{g/dl}$, respectively. Their haemoglobin level and RBC count were 7.2 ± 0.75 g/dl and 2.83 ± 0.2 million/ μL , respectively. Observed haematocrit value among them was $20.9 \pm 2.2\%$ (Table 1).

Table 1: Observed levels of different parameters in haemodialysis patients

Study Parameter	Study Subjects (Mean \pm SD)	Normal Subjects (Range)
Plasma Zinc ($\mu\text{g/dl}$)	68.7 ± 6.22	80 - 120
Corpuscular Zinc ($\mu\text{g/dl}$)	1510.9 ± 93.8	1000 - 1300
Haemoglobin level (g/dl)	7.2 ± 0.75	12 - 16
RBC count (Million/ μL)	2.83 ± 0.24	4.5 - 5.5
Haematocrit (%)	20.9 ± 2.2	42 - 45

They had hypozincaemia (68.7 ± 6.2 $\mu\text{g/dl}$) in comparison to the normal healthy subjects (130.4 ± 13.1 $\mu\text{g/dl}$). Rather they had higher corpuscular zinc level when compared to that of normal healthy subjects.

A significant correlation (Pearson correlation) was observed (Figure 1) between plasma zinc level and

haemoglobin level ($r=0.69$; $p<0.01$). RBC count was also found to have a significant association (Figure 2) with plasma zinc level ($r=0.54$; $p<0.05$).

Neither haemoglobin level nor RBC count showed any correlation with corpuscular (RBC) zinc level. Haemoglobin level as well as RBC count didn't show any correlation with the observed haematocrit value.

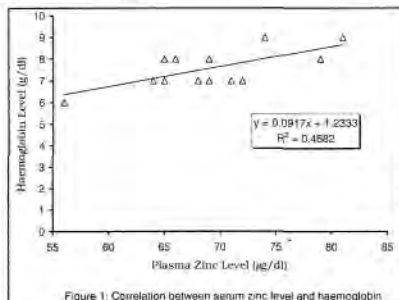


Figure 1: Correlation between serum zinc level and haemoglobin

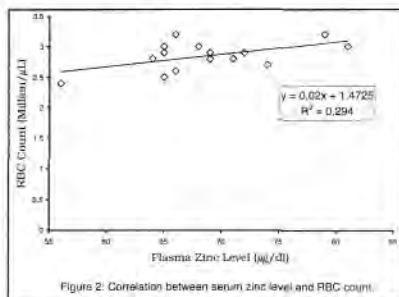


Figure 2: Correlation between serum zinc level and RBC count

Discussion

Abnormalities in the metabolism of zinc is associated with haemodialysis anemia. In our patients, plasma zinc levels were significantly lower than that in normal subjects. This finding is in agreement with other researchers.^{4,5,6,8,9,10} This hypozincaemia may be due to shift of zinc from plasma into other cells and tissue, ingestion of aluminium hydroxide along with ferrous sulphate causing more faecal loss of zinc (competitive

inhibition), hypoproteinaemia due to restricted intake of protein, which is an important source of zinc, leading to decreased binding capacity for zinc and altered homeostatic mechanism at gastrointestinal tract level. In our patients, corpuscular zinc levels were significantly high. This finding is in accordance with others.^{5,7,11,12} They reported that increase in corpuscular zinc causes anaemia due to disturbance in haem synthesis, specifically involving δ -aminolaevulinic acid dehydrogenase in haemodialysis patients. Some workers reported that anaemia in haemodialysed patients might be due to reduction of life span of RBC because of acidosis.^{13,14}

Low plasma zinc and high level of corpuscular zinc in HD patients might represent an abnormal shift of serum zinc into erythrocytes resulting in ineffective erythropoiesis associated with decreased rate of cell division and maturation.⁴

All of our subjects were found anaemic who had mean haemoglobin level and RBC count of 7.2 ± 0.75 g/dl and 2.83 ± 0.24 million/ μ L, respectively. Plasma zinc concentration significantly correlated with RBC count ($r=0.54$; $p<0.05$) and haemoglobin level ($r=0.69$; $p<0.01$) in our patients. This finding is in accordance with other studies.^{5,12} However, we did not find any significant correlation of corpuscular (RBC) zinc level with haemoglobin level and RBC counts. These facts suggest that altered zinc levels in plasma and red blood corpuscles might be involved in producing dialysis anaemia.

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