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PLASMA, ERYTHROCYTE AND URINARY SELENIUM LEVELS IN SICKLE CELL HOMOZYGOTES AND TRAITS*

*Yurdanur Kılınç MD***

SUMMARY: Kılınç Y. (Pediatric Hematology Unit, Department of Pediatrics, Çukurova University Faculty of Medicine, Adana, Turkey). Plasma, erythrocyte and urinary selenium levels in sickle cell homozygotes and traits. Turk J Pediatr 35: 105-109, 1993.

Plasma, erythrocyte and urinary selenium levels were determined in 21 sickle cell homozygote patients, 20 siblings with sickle cell traits, 29 parents and in 21 healthy controls with an HbAA pattern. The mean levels of plasma and erythrocyte selenium and the daily urinary selenium depletion were found to be lower in the HbSS patients than in the controls ($p<0.02$; $p<0.001$; $p<0.001$, respectively). Urinary selenium depletion was found to be lower in the sickle cell trait siblings than in the controls ($p<0.001$), but the plasma and erythrocyte selenium levels were close to normal values ($p>0.05$). The mean erythrocyte selenium levels were found to be decreased in the parents as compared with the controls ($p<0.05$), which indicates that urinary selenium losses may be replenished primarily by sources in the plasma and in the erythrocytes before stores in the other parts of the body are used. *Key words: selenium, plasma, erythrocytes, urine.*

Selenium which exists mainly as compounds in nature is a trace element essential for man. It plays an important role in erythrocytic glutathione peroxidase (GSH-Px) activity. GSH-Px helps inactivate free radicals and peroxides, thereby, preventing tissue damage[1]. Selenium is found mainly in the liver, lens of the eyes, vascular endothelium, erythrocytes, heart, lungs, kidneys and in skeletal muscle. Fatty liver necrosis has been reported in guinea pigs[2] and smooth muscle disease in sheep[3] deficient in selenium. In addition, decreased microbicidal activity in neutrophils via deficient glucose utilization and reduced CO_2 synthesis[1] have been demonstrated in selenium deficient individuals. In China, Keshan disease has been reported in patients with low serum selenium concentrations[4], while in the United States, a diet deficient in selenium has been correlated with cardiomyopathy[5,6].

Sickle cell disease (SCD) is a chronic hemolytic disorder associated with recurrent vaso-occlusive events, organ dysfunction and anemia. Alterations in the selenium status and GSH-Px activity may affect vessel endothelium, and may give rise to insufficient tissue nutrition and perfusion.

This study was designed to determine the selenium status of patients with the hemoglobin S gene and of healthy age-matched controls. Comparisons were

* From the Pediatric Hematology Unit, Department of Pediatrics, Çukurova University Faculty of Medicine, Adana.

** Associate Professor of Pediatrics.

made between the selenium values of the homozygote HbSS patients, their siblings with the sickle cell trait and the parents.

Material and Methods

The study population consisted of twenty-one patients with homozygote sickle cell disease (HbSS) in the asymptomatic phase, 20 heterozygous (HbAS) siblings and 29 parents, who were selected from patient groups. The control group consisted of 21 healthy children with a HbAA pattern. Parental consent was obtained for all children who took part in the study.

The homozygote group consisted of 11 females and 10 males. The age range was from 3 to 17 years, with a mean age of 8 years. The sibling group consisted of 10 females and 10 males, with a mean age of 9 years 7 months. The parental group consisted of 17 females and 12 males. The age range was from 24 to 57 years, with a mean age of 35 years. The age range of the control group was from 3 to 22 years, with a mean age of 9 years 10 months.

Laboratory evaluation consisting of hemoglobin electrophoresis in which cellulose acetate strips with a pH of 8.6[7] were used was performed uniformly in all patients, siblings and parents. The fetal hemoglobin level was determined by the method of Betke et al[8]. The hemoglobin A_2 value was determined by scanning the electrophoretic strips and also by means of DEAE-Cellulose chromatography using Glycine-KCN developers[9]. Sickling tests were performed in all cases. Other routine hematological tests were carried out by conventional methods[10]. Blood samples were obtained by venipuncture and collected in demineralized and heparinized polystyrene tubes for plasma and erythrocyte selenium determinations. Daily urinary selenium excretions were also determined. Plasma, erythrocyte and urinary selenium levels were measured by a Turner Type III fluorometer using the method of Dye et al[11]. Statistical analyses were performed by using the Student's *t* test and correlation analysis.

Results

Plasma, erythrocyte and urinary selenium values of patients, siblings, parents and controls are presented in Table I. No statistical differences were found in the plasma selenium values between patients, siblings and parents. However, there was a significant difference in the plasma selenium levels between patients and controls ($p<0.02$).

There were significant differences in the erythrocyte selenium levels between patients and controls ($p<0.001$), and a slight difference between parents and controls ($p<0.05$). No other statistical difference was found comparing the other groups with each other ($p>0.05$).

Table I: Selenium Values in Plasma, Erythrocytes and Urine in Sickle Cell Homozygotes and Heterozygotes and in Healthy Controls

Hemoglobin Pattern	Plasma (μg/L) Mean ± SD (Low-High)	Erythrocyte (μg/ml) Mean ± SD (Low-High)	Urine (μg/day) Mean ± SD (Low-High)
HbSS (21) Patients	0.020 ± 0.004 (0.012 – 0.028)	0.085 ± 0.026 (0.050 – 0.140)	13.06 ± 9.33 (2.10 – 33.75)
HbAS (20) Siblings	0.025 ± 0.008 (0.014 – 0.047)	0.111 ± 0.036 (0.067 – 0.175)	10.05 ± 8.29 (1.35 – 32.00)
HbAS (29) Parents	0.023 ± 0.011 (0.010 – 0.044)	0.103 ± 0.032 (0.050 – 0.186)	21.76 ± 24.73 (4.00 – 70.10)
HbAA (21) Controls	0.031 ± 0.015 (0.017 – 0.062)	0.122 ± 0.046 (0.044 – 0.224)	38.62 ± 25.25 (10.70 – 95.92)

Daily urinary selenium excretions did not differ statistically between the patients and their siblings ($p>0.05$), but, there was a slight difference in mean selenium values between siblings and parents ($p<0.05$). However the most significant finding was that there was a highly significant difference in the daily urinary selenium excretions between patients, siblings and controls, respectively ($p<0.001$; $p<0.001$).

Discussion

In various types of hemolytic anemias, peroxide and free radical-induced hemolysis increases concomitantly with decreased Vitamin E and selenium levels[12]. Selenium plays an important role not only in protecting erythrocytes against oxidative damage, but is also effective in the maintenance and utilization of GSH.

Rotruck et al[13] reported that hemoglobin oxidation and hemolysis of erythrocytes may be prevented by selenium. Vitamin E also provides important protection against membrane oxidation, but cannot prevent hemoglobin oxidation. The high levels of GSH-Px observed in cases of selenium deficiency may be explained by the fact that selenium is required for the utilization, but not for the maintenance of GSH.

In our study there was a moderate difference in the plasma selenium levels between the HbSS patients and the controls ($p<0.02$). Natta et al[14] reported low plasma selenium and glutathione peroxidase levels in patients during a crisis and in those during the asymptomatic phase of the disease. Data supporting the

presence of oxidative stress in SCD indicate that it may affect the capillary bed endothelium leading to capillary tissue or organ dysfunction.

As shown in Table I, selenium concentrations in the plasma and in the erythrocytes of the homozygote patients were visibly low which may indicate that these patients are selenium deficient, the reason for which is unclear. It however may be related to the absorption, storage or mobilization of this trace element because the daily urinary excretion of selenium could not be an explanation for this loss. Although the selenium values in the siblings and in the parents were not as low as those found in the patients, they clearly demonstrate selenium deficiency when compared with the levels found in the healthy controls. This finding suggests that selenium is utilized in GSH-Px activity. In another study we conducted in 1984, we found low levels of selenium in erythrocytes, excessive urinary depletion of selenium and normal or high plasma selenium levels in patients with thalassemia major[15].

These findings suggest that the erythrocytes are one of the most important and sensitive, but not the sole-parameter of selenium storage. Thomson and Robinson[16] reported a positive correlation between erythrocyte GSH-Px activity and plasma selenium concentrations less than 150 μg/L. Rea et al[17] found that selenium storage may be restricted to the erythrocytes when erythrocyte selenium levels are below 0.15 μg/ml. Our results are consistent with the literature. In conclusion, we wish to note that low selenium stores in SCD patients may also affect the phenotypic expression in these patients.

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