EVALUATION OF ZINC, SELENIUM AND LIVER ENZYMES IN CHILDREN AND TEENAGERS WITH THALASSEMIA DISEASE

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ABSTRACT

Thalassemia is an inherited disease of genetic origin, in which hemoglobin is distorted. Two types of thalassemia is found according to which chain of hemoglobin affected, which are beta- and al phathalassemia. The study included 60 patients with beta-thalassemia collected from Ibn-Al-Baladi Hospital and 40 healthy control. The levels of zinc and selenium were analyzed by using atomic absorption spectroscopy whereas ALT and AST were analyzed by spectrophotometric methods. The age were non-significantly (P>0.05) differ in patients than that in controls. Zinc and selenium were significantly lower (P<0.01) in thalassemia patients compared to control. The activities of ALT and AST were significantly higher in thalassemia patients compared to control. Zinc and selenium had not shown any significant association with each other or with ALT and AST. The hyposelenemia and hypozincemia suggest the use of both zinc and selenium in the treatment of thalassemia disease, also it may indicate progression of oxidative stress as the two elements involved in the machinery of antioxidant enzymes.

Keywords: Thalassemia, zinc, selenium, ALT, AST.

I. INTRODUCTION

Thalassemia is an inherited disease of genetic origin, in which the hemoglobin molecules are distorted [1]. Hemoglobin comprises of alpha and beta ‘chains’ which, in a patient with thalassemia, are faulty as a result of which the hemoglobin produced is faulty. In a patient with thalassemia, problems arise because there is a lack of healthy hemoglobin that the body requires for it to become properly oxygenated. A patient with thalassemia, not only has lower levels of hemoglobin present in his or her bloodstream but also lacks good quality hemoglobin. At the same time, the patient’s body continues trying to produce more red blood cells and hemoglobin. However, since there is a genetic fault with the hemoglobin being produced in that individual’s body, the new hemoglobin produced, causes further problems as an overproduction of unhealthy hemoglobin takes place. Individuals with thalassemia can be treated according to the level of severity of their condition [2, 3].

Thalassemia can lead to significant morbidity and mortality when not appropriately managed, relating to anemia, ineffective erythropoiesis, and iron overload. The genetics of thalassemia is complex, its complications are numerous, and while there are currently possible options for prevention or cure, more is being done to better manage these intricate illnesses [4]. There are two main types of thalassemia, the major β-Thalassemia which is inherited as an autosomal recessive disorder characterized by a microcytic hypochromic anemia. It is probably the most common monogenic gene disorder in the world and is especially frequent in Mediterranean countries, Southeast Asia, Africa, Middle Eastern countries, and in the Indian subcontinent, and is now commonly found in North-European countries and Northern America because of demographic changes [5]. Over 200 different mutations of the β-globin genes have been found in patients with β-thalassemia. They may affect gene function at any level between transcription, processing of the primary messenger RNA transcript, translation, or stability of the β-globin chain. Rarely, β-thalassemia, like α-thalassemia, may result from a deletion of the β-globin gene.
Some of these mutations result in no β-chain production and the disease is called ‘β⁰-thalassemia’, while others cause a reduced output of β chains, β⁺-thalassemia. Some of the latter forms are extremely mild and may not be identifiable in carriers; most heterozygotes for β-thalassemia have very mild anemia and an elevated level of HbA₂ [6].

The other main type of thalassemia is α-type. There are two genetic loci for α gene resulting in four genes (alleles) for α hemoglobin (α/α, α/α) on chromosome 16. Two alleles are inherited from each parent. α-Thalassemia occurs when there is a defect or deletion in one or more of four genes responsible for α-globin production. α-Thalassemia can be divided into four categories: The silent carriers, α-Thalassemia trait, α-Thalassemia major and Hydrops fetalis [7]. The study designed to investigate the levels of zinc and selenium trace elements in children and teenagers with thalassemia as well as determine the activities of ALT and AST enzymes in these patients.

II. MATERIALS AND METHODS

Subjects and samples
Total of 100 subject were tested. 60 patients who already diagnosed with β-thalassemia were submitted and collected from Ibn Al-Baladi Hospital, Baghdad from Feb to Apr 2021. Another 40 healthy individual were used as control group. The vein blood was withdrawn and the serum was collected from each subject at 1500g centrifugation. The serum was separated onto 4 Eppendorf and stored at -20 °C until the time of analyses.

Methods
For the determination of zinc and selenium AA-7000 Atomic absorption spectrophotometer was used. The activities of ALT and AST were determined by using kit supplied from Biomerieux (France). The statistical analyses was processed by using SPSS-26 as independent t-test to compare each two means, Chi-square for percentages and Pearson’s correlation coefficient (r).

III. RESULTS

The results are demonstrated in the form of mean±SD and range (minimum and maximum values). There were no significant (P>0.05) differences in age between control (9.39±3.17 year) and patients (8.14±3.72 year). The gender distribution was non-significant (P>0.05) between the two groups, Table 1.

Table 1: The age of participants.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control (N=40)</th>
<th>Patients (N=60)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>9.39±3.17 (1.5-14.0)</td>
<td>8.14±3.72 (1.5-14.0)</td>
<td>0.076</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>47.5%</td>
<td>60%</td>
<td>0.218</td>
</tr>
<tr>
<td>Female</td>
<td>52.5%</td>
<td>40%</td>
<td></td>
</tr>
</tbody>
</table>

The level of zinc has reduced highly significantly (P<0.01) in thalassemia patients (0.872±0.530 µg/mL) compared to healthy control (1.372±0.936 µg/mL). The level of selenium has reduced highly significantly (P<0.01) in thalassemia patients (213.66±35.65 µg/mL) compared to healthy control (248.26±56.78 µg/mL). The activity of ALT has shown significant (P<0.05) increase in the serum of thalassemia patients (22.43±9.64 U/L) compared to healthy control’s serum (18.48±5.67 U/L), and the activity of AST has shown highly significant (P<0.01) increase in the serum of thalassemia patients (28.26±9.16 U/L) compared to healthy control’s serum (23.31±6.94 U/L), Table 2.

Table 2: The level of parameters in patients and control.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Control (N=40)</th>
<th>Patients (N=60)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zinc (µg/mL)</td>
<td>1.372±0.936 (0.25-3.39)</td>
<td>0.872±0.530 (0.1-2.64)</td>
<td>0.003</td>
</tr>
<tr>
<td>Selenium (µg/mL)</td>
<td>248.26±56.78 (223.24-396.41)</td>
<td>213.66±35.65 (128.76-308.63)</td>
<td>0.001</td>
</tr>
<tr>
<td>ALT (U/L)</td>
<td>18.48±5.67 (11.10-36.0)</td>
<td>22.43±9.64 (6.90-52.90)</td>
<td>0.011</td>
</tr>
</tbody>
</table>
There were no significant association of zinc and selenium neither with each other nor with ALT and AST in thalassemia patients. The only observed association was between ALT and AST, Table 3.

Table 3: The association among parameters according to Pearson’s coefficient.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Zn</th>
<th>Se</th>
<th>ALT</th>
<th>AST</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r</td>
<td>p</td>
<td>r</td>
<td>p</td>
</tr>
<tr>
<td>Zn</td>
<td>-</td>
<td>-</td>
<td>0.142</td>
<td>0.278</td>
</tr>
<tr>
<td>Se</td>
<td>0.142</td>
<td>0.278</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>ALT</td>
<td>0.047</td>
<td>0.719</td>
<td>0.023</td>
<td>0.861</td>
</tr>
<tr>
<td>AST</td>
<td>0.029</td>
<td>0.825</td>
<td>0.032</td>
<td>0.809</td>
</tr>
</tbody>
</table>

IV. DISCUSSION

The results have indicated hypozincemia and hyposelenemia in children and teenagers with thalassemia disease. These results are agreed with studies from different countries and ethnicities, Al-Sammaraie et al have reported low serum levels of zinc in Iraqi children and teenagers with thalassemia compared to healthy ones [8]. Another study in Iraq by Al-Khazraji indicated low level of selenium in thalassemia patients, and demonstrated that blood blood transfusion has no effect on selenium level [9]. Fikry et al have reported significant lower levels of zinc among Egyptian patients with thalassemia disease, the workers have suggest the use of zinc supplementation as part of the therapy [10]. Hamdy et al have reported hyposelenemia in thalassemia patients in Egypt [11]. Further studies are confined with the current outcomes [12-14]. Although, a disagreement has found with a study in Jorden which reported significant increase in zinc level of thalassemia patients [15], supported by Turkish study [16].

The low levels of zinc in thalassemia has been attributed to proximal tubular damage, hemolysis-induced hyperuricemia, chelating effects of deferoxamine and deferiprone and increased ferritin levels and high levels of zinc in the blood to cirrhotic changes, due to hemosiderosis and abnormal glomerular filtration rate [17]. A study has suggested that zinc has the ability to decrease the complications of beta-thalassemia [18]. Minerals are essential for growth, development and physiology of the human body [16]. Zinc and selenium are required in many enzymatic reaction especially in antioxidant defense system as zinc is a cofactor for superoxide dismutase enzyme and selenium in glutathione peroxidases [19]. The antioxidants play fighting role against free radicals and reactive oxygen species which can cause oxidative damage to cell components and lead to a dysfunction in vital cell; hence develop oxidative stress complications [20]. Researchers have reported significant correlation between minerals levels and antioxidant capacity in thalassemia patients [21].

In the present study the liver enzymes, ALT and AST, were at higher activities in patients with β-thalassemia. Many studies have reported significant increase in the activities of ALT and AST enzymes in thalassemia patients [22-25]. The liver of thalassemia patients is injured probably due to elevated free radicals [26]. High iron status of thalassemia patients involved strongly in the progression of oxidative stress and increase the free radicals level [27]. It was reported that iron overload is a main leading cause of elevated liver enzymes and presence of HCV infection is significantly related to the increased iron overload [22].

V. CONCLUSIONS

The current findings indicate low levels of zinc and selenium elements in thalassemia. This reduction could follow up intrinsic mechanism leaded by iron overload effects or dietary habits. Both of zinc and selenium are important during the antioxidative operation as cofactors of SOD and GPx, respectively. The supplementation of zinc and selenium in thalassemia should be considered to avoid the arisen complications of oxidative stress and provide sufficient mineral homeostasis in the body system.

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REFERENCES