Original Research Article

Determination the Levels of Zinc and Copper in Patients with Leukemia

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ABSTRACT

Leukemia is the most common type of blood cancer in which both of zinc and copper levels are altered resulting in many metabolic and physiological disorders. This alteration is controversial, the reason why this study is worked. This study comprised 50 patients with leukemia (chronic and acute) where 35 males and 15 females, their mean ages were (48.50 ± 15.06, 34.30 ± 12.05 years for males and females respectively while the control group included 15 healthy participants. During the period from December 2012 to March 2013, the cases with leukemia were enrolled from patients admitted to Al –Sader teaching Hospital. The design composed of two groups, the study group which included fifty patients whom afflicted with leukemia, there were Control group which included healthy individuals consisted from 15 persons. Zinc and copper were determined according to the colorimetric determination using the available kits. Zinc levels were significantly lower (p < 0.001) in acute leukocyte leukemia (ALL) and chronic myelogenous leukemia (CML) than in the control. While copper levels were demonstrated a significant (p < 0.001) increased in chronic myelogenous leukemia (CML) and acute lymphocyte leukemia (ALL) compared with control group.

Keywords
Antioxidant, Copper, Leukemia, Zinc

Introduction

Leukemia is the most common type of blood cancer including white blood cells (leukocytes) which are potent infection fighters. Excessive increasing in immature leukocytes number resulted from the malicious tumors of the arising and infiltrating of the hematopoiesis tissues of the bone marrow. It is considered as a progressive disorder which occurred in chronic and acute forms. Moreover, another classification of leukemia depends on the damaged cells such as myeloid and lymphoid cells (Hope et al., 2004).

Many factors are involved in leukemia, such as abnormality of the chromosomes, viruses, irradiations, and chemicals (Bloomfield et al., 1986)

Cancer patients usually have inadequate energy and protein intakes, increased metabolic rate and abnormalities in energy, carbohydrate, lipid and protein metabolism. Cancer therapy with chemotherapy and radiation therapy is also potentially damaging to nutritional status (Wesdorp et al., 1983). Trace elements are basic
foodstuffs as well as they consider a frequent contaminated dietary of the environment (Gottlieb and Drewinko, 1975). It is performing the processing of the physiologic and metabolic body function (Mertz, 1981). Zinc, the more prolific intracellular trace elements, exhibits the preventive effect on the gene mutations and transformation the cells through its effective anti-oxidant factor by its ability to obligation and protection the sulphhydrils of the protein from radical attack. Furthermore, it organizes the catalytic activity of many enzymes which belong to the main categories of the mammary enzymes. In addition to its stabilizing effect in the tertiary and quaternary of protein structures and its association to certain sites in protein (Ho, 2004; Washabaugh and Collins, 1986).

Zinc role as antioxidant include remove superoxide ion through the enzyme of superoxide dismutase by the obstruction formation of hydroxyl ion through the activation of oxidation of transition metals such as, copper and iron (Conte et al., 1996). Reactions of detoxification and responses to the stress depend on the metallothioneins activity and expression regulation (Bloomfield et al., 1986; Malemud, 2006). Deficit or excessive levels zinc as a trace elements has effect on the balance of the global cellular anti-oxidant, and several carcinogen effects, which includes, DNA repairing, synthesis of DNA, implication on mutations proliferation of cells, apoptosis and differentiation, these had important role in the maintaining DNA integrity (Fong and Magee, 1999; Nasulewicz et al., 2004), and second it involved in membrane transport, nerve conduction and muscle contraction and also in the function of sub-cellular systems such as mitochondria (Senturker et al., 1997). In addition, trace elements such as zinc and copper act as antioxidants (Bakan et al., 2003) for leukemia the distribution levels of these trace elements represents the uncontrolled proliferation of cell as seen in leukemia. This study was undertaken to examine the levels of essential elements, zinc and copper in patients with leukemia.

Materials and Methods

This study of trace elements in leukemia is carried out by assisting a pathologist who has had a wide experience in this field, samples are collected from patients according to the approval ethics in biochemical research. The period range was from December 2012 to March 2013. Patients with leukemia were recruited from those attending Al –Sader teaching hospital.

A group of studied population comprised fifty patients (chronic and acute) whom afflicted with leukemia (35 males and 15 females), their mean ages were 48.50 ± 15.06 and 34.30 ± 12.05 years for males and females respectively. While control group involved healthy individuals and it included 15 persons which are selected according to sex, age, to match study group patients. The control group was used only for comparing serum zinc and copper levels. Blood samples collected from both groups and saved in plain tubes for subsequent analysis. Both of zinc and copper are determined according to the colorimetric determination using the available kits (Pasquinelli, 1984; Abe et al., 1989).

The descriptive data of patients with leukemia and controls in studied population are summarized in table 1.

Statistical analysis

Results are expressed as mean and standard deviation (mean ± SD). Student-t test was used to determine the difference between groups. P value <0.05 was considered statistically significant.
Results and Discussion

During the current research the following results were obtained. Zinc levels were significantly lower (p < 0.001) in acute leukocyte leukemia (ALL) and chronic myelogenous leukemia (CML) than in the control. While copper levels were significantly increased in the leukemic group, chronic myelogenous leukemia (CML) and acute lymphocyte leukemia (ALL), compared to the control group (p < 0.001) as demonstrated in table 2 and figure 1.

Leukemia is a neoplastic disease that is susceptible to essential elements alterations such as zinc and copper. Studies related to zinc and copper levels in leukemia development are controversial and deserve further analysis. Therefore, in this study we analyzed and followed potential role of zinc and copper as antioxidant for oxidative damage in leukemia patients by analyzing serum levels of previous antioxidant.

In this prospective study of leukemia patients zinc levels are decreased when compared with controls. The significant decreased of zinc levels in patient groups could be expected to offer a lot of factors are involved in leukemia and the oxidative stress related it.

Thus, the role of development leukemia stage with decreased zinc is clear and the explanations in many prospective studies demonstrated that leukemic cells contain much less zinc than normal lymphocytes, suggesting an error in zinc metabolism. Studies by Beguin et al. (1987) and Mrozek et al. (2006) investigated the association between zinc deficiency and DNA replication and RNA polymerization. Whereas zinc deficiency associated with T cell function, impaired cellular immune function and occurrence of a lymphoid system (Zowczak et al., 2001; Choudhury et al., 2003). Increasing evidence of clinical and experimental indicates that leukemia plays a major role in the damage antioxidant balance by results in disturbances of thymic hormone activity and T-cell maturation (Gürses et al., 2000).

On the other hand, the lifestyle of the patients in the studied population could be impact on the levels of trace elements since almost of them live in districts area and have a bad situation of living. However, administration of leukemic patients with zinc treatment has beneficial effect (Caporaso et al., 2004).

In the present study copper levels were found to be increased in patients groups compared with controls. In particular, copper was transition metal, and an essential element in the biological systems, and its function is related to this redox properties (Tracey and Carter, 2005; Harrison et al., 2000).

These finding were consisted with that elevation of serum copper have been found in the pathologic conditions which accompanied by increased rate of tissues destruction and / or proliferation (Bakan et al., 2003).

In another study of antioxidant activity in leukemia, Beguin et al. (1987) suggested that elevated leukemia burden as marker of development leukemia stage that is independent of other risk like increased levels of serum copper. Our results point to a possible relationship between high levels of copper and developed stage of leukemia. Also, it has suggested that accumulated of copper may enhance tumorigenesis (Nasulewicz et al., 2004).
Table 1: Descriptive data of leukemic patients and controls in studied population

<table>
<thead>
<tr>
<th></th>
<th>Age (mean± SD)</th>
<th>No. of cases</th>
<th>percent</th>
<th>occupation</th>
<th>places</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Males</td>
<td>48.50±15.06</td>
<td>35</td>
<td>70%</td>
<td>Earner(30)</td>
<td>District(28)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Student(5)</td>
<td>Al-Najaf(2)</td>
</tr>
<tr>
<td>Females</td>
<td>15</td>
<td>30%</td>
<td></td>
<td>House wife(15)</td>
<td>District(12)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Al-Najaf(3)</td>
</tr>
<tr>
<td>Controls</td>
<td>15</td>
<td>30%</td>
<td></td>
<td>Employee(13)</td>
<td>Al-Najaf(15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Student(2)</td>
<td></td>
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</table>

Table 2: Association between zinc and copper levels in leukemia patients

<table>
<thead>
<tr>
<th>Variables</th>
<th>No.</th>
<th>Zinc (µg/dl)</th>
<th>Copper (µg/dl)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>15</td>
<td>74.90± 2.84</td>
<td>77.50 ± 4.81</td>
</tr>
<tr>
<td>patients</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ALL</td>
<td>30</td>
<td>41.60 ± 14.90*</td>
<td>214.00 ± 70.20*</td>
</tr>
<tr>
<td>CML</td>
<td>20</td>
<td>43.2± 13.60*</td>
<td>235.00± 69.90*</td>
</tr>
</tbody>
</table>

*P< 0.001 compared to the Control groups.

Figure 1: Comparison between zinc and copper levels in control, ALL, and CML groups

The present study indicated imbalances in the levels of zinc and copper of leukemia patients may adversely affect the biological processes of DNA that lead to the uncontrolled proliferation of cells and defect DNA function. The disturbances are consisted respective with the stage of the disease.

References

Bakan, N., Taysi, S., Yilmaz, Ö. et al. 2003. Glutathione peroxidase, glutathione reductase, Cu-Zn superoxide dismutase activities, glutathione, nitric oxide, and


