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Short Communication

Determination of Trace Metals Abnormalities in Patients with Vivax Malaria

S Baloch[1], *SA Memon[2], GS Gachal [1], M Baloch [2]

[1]Department of Zoology, University of Sindh, Jamshoro, Pakistan
[2]Dr MA Kazi, Institute of Chemistry, University of Sindh, Jamshoro, Pakistan

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ABSTRACT

Background: In the present study, blood serum level of metals were determined in malarial patients and compared with those in the normal subjects without complication using Atomic Absorption Spectrometer.
Methods: For the determination of these metals twelve intravenous blood samples each from referred malarial patients and a group of normal subjects were collected and immediately centrifuged to obtain the supernatant liquid, serum of both the groups for analysis.
Results: The blood serum levels of copper in malarial patients determined to be 2.6917 ppm, which is higher as compared to that found 2.045 in normal subjects. Whereas the blood serum levels of iron, magnesium, and zinc found 2.0708 ppm, 12.2467 ppm and 4.9017 ppm respectively in malarial patients, who are lower than those, are determined in the blood serum of normal subjects. Blood serum levels of iron, magnesium, and zinc in normal subjects found 3.950 ppm, 19.4892 ppm, and 5.242 ppm respectively.
Conclusion: In this study the metal content of copper, iron, magnesium and zinc in vary in malarial patients as compared those in the normal subjects. It may suggest that the decreased levels of iron, magnesium, and zinc can be maintained by giving as supplement of these metals in therapy.

Keywords: Malaria, Serum, Trace Metals, Atomic Absorption Spectrometer

***Corresponding author: Email:** sikandermemon48@yahoo.com

Introduction

Plasmodium vivax is the second most prevalent species causing malaria. Malaria is transmitted to people through the bites of infected mosquitoes and can often be fatal if not treated promptly with proper medication (1). Metals such as copper, iron, magnesium, and zinc are essential for different biological functions in human beings and are co-factors in most of the enzymes. The variation in these metals lead to impairment of biological functions from optimal to sub optimal levels resulting abnormalities in metabolism. Many of these metals have been essential elements for utilization by the body to ensure good health, but the function of these metals and their benefits to the body is still uncertain and has been widely speculated (2).

It is reported (3) that there is no difference in the blood serum zinc levels, between the malarial patients and the control cases. Similar results are also reproduced, where malarial infection did not affect the serum zinc levels (4) however; in acute phase of malaria zinc is redistributed from plasma to lymphocytes and to the liver, decreasing zinc plasma levels in microbio- static environment (5). Literature reveals that serum zinc levels vary inversely with malaria parasitemia. Where the deficiency of zinc is beneficial for malarial patients due to the reduction of zinc in circulation reduces the metabolism of microorganisms during infection. Similarly, the deficiency of iron in blood serum levels give the same advantage as is for the zinc depletion (6).

Serum magnesium levels determined is elevated in patients might be due to hemolysis arising from erythrocytic merogony containing high amounts of magnesium. The increased serum magnesium levels have potential application as a biomarker of acute falciparum malaria in adults (7).

Since various controversial results on metals are reported in many reported studies, it is difficult to determine the role of these metals in malarial patients; hence, we have studied these patients to define the role of such metals in order to recommend additional nutritional therapy in treating these patients.

Trace metals are reviewed briefly in this study of trace metals including copper, iron, and zinc in the serum of malarial patients in comparison to normal subjects. The deficiencies and excesses in serum have been documented during malaria, and also determined magnesium serum level, which is of possible but unconfirmed health significance. Little is known on the role of trace metals such as copper, iron, magnesium, and zinc level in malarial patients in comparison to control subjects. This Study will contribute to open up a way to therapeutic approach in treating malarial patients (8).

Materials and Methods

The metals copper, iron, magnesium, and zinc in the blood serum were determined by Atomic Absorption Spectrometry (AAS) (Model, A-20 Varian).Trace metals were determined using air-acetylene flame.

The standards from 1 to 5 ppm for each of the metal separately were run on the spectrometer and the calibration curves were obtained prior to run the samples for the determination of metals in the blood serum of normal subjects and the malarial patients.

Ten ml venous blood samples of 12 healthy controls and same number of malarial patients in fasting condition were collected in sample tubes without the addition of anticoagulants. The blood collected was made to clot, centrifuged at 600 rpm and the supernant serum was separated, collected, and stored at -40^{o} C prior to analysis of trace

metals (Cu, Fe, Mg, and Zn).
Blood samples were collected from 12 healthy controls in fasting conditions and a similar condition was maintained while taking blood samples of confirmed malarial patients. Each blood sample was centrifuged at 5000 rpm for 20 min. The supernatant blood serum was used for the analysis of metals copper, iron, magnesium, and zinc using Atomic Absorption Spectrometer inserting appropriate hollow cathode lamp in it. All standards used were of analytical grade.

Chemicals and reagents
Sulphosalicylic acid was obtained from Merck, Damstadt, Germany and other chemicals to prepare standards were purchased from Sigma Chemical Co. All chemicals were of analytical grade.

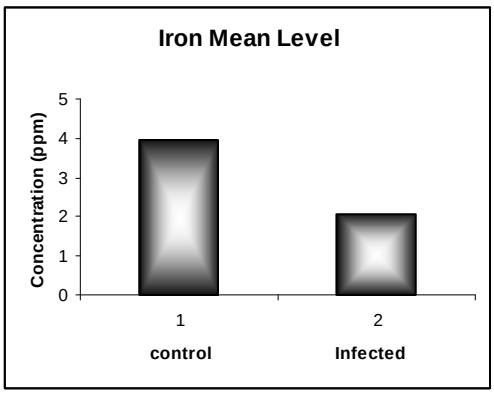
Stock Solutions and working Metal standards
Stock solution of 1000 ppm Cu, Fe, Mg, and Zn for each were prepared for corresponding sulphate salts of analytical grade (Sigma Chem.). Working standards were prepared from the stock solutions by diluting with appropriate volume of deionized water and addition of few drops of corresponding concentrated acid.

Results

Table 1 shows the blood serum levels of metal contents malarial patients with compare to control subjects. The results show significant increase in serum copper levels as compared to the controls, where as serum iron, serum magnesium levels is decreased in malarial patients as compared to the controls with $P<0.001$, and zinc among all analyzed samples are significantly reduced in malarial patients (Fig.1, 2).

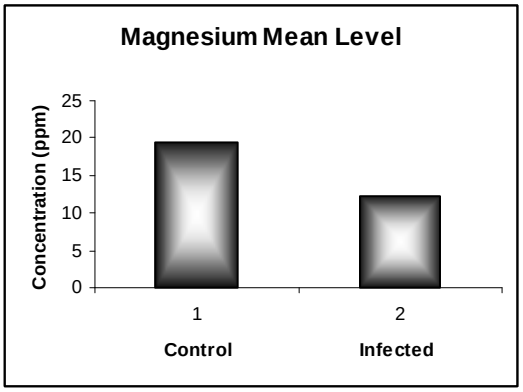
Table 1: Blood serum level of Metal content

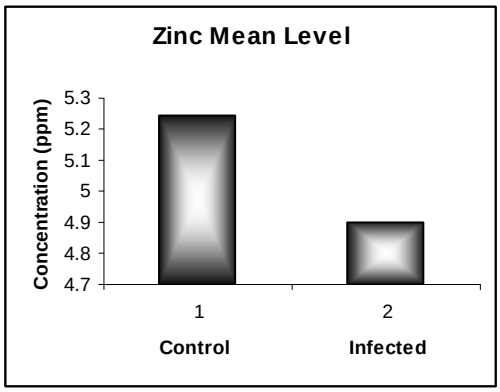
Blood Serum Level	No. Of Patients	Healthy Subjects (Mean ± S.D)	Malarial Patients (Mean ± S.D)
Age (yr)	12	45.92 ± 6.44	34.67 ± 7.22
Copper (Cu) ppm	12	2.045±0.62	2.6917±1.30
Iron (Fe) ppm	12	3.950±1.34	2.0708±0.50
Magnesium (Mg) ppm	12	19.4892±4.04	12.2467±3.88
Zinc (Zn) ppm	12	5.242±1.95	4.9017±2.83



1(a) 1(b)

Fig. 1: (a) The elevated copper mean level result in serum of control and malarial patients where as figure (b) The decreased Iron mean level result in serum of control and malarial patients





2(a) 2(b)

Fig. 2: (a) The reduced magnesium means level result of control and malarial patients while figure 2(b) Decreased zinc mean level result of control and malarial patients

Discussion

Figure 1(a) shows copper mean value characterized as elevated trace metal during the infection of malaria. Wilson's disease is developed with the increase level of copper in patients with malaria if not treated properly well in time. Copper is found in a variety of enzymes, the third most abundant trace metal in the human body. Metals zinc and copper compete for absorption in the digestive tract in a situation where, a diet containing excessive in one of these metals may result in a deficiency in the other (9). However, in the present study the copper (Cu) serum levels to be 2.6917 significantly higher in vivax malarial patients as compared to those in healthy subjects.

Figure 1(b) shows the mean values of Iron, a decreased status in body by the attack of malaria. Iron is required in the body for the synthesis of blood (10). The human body nor-

mally contains 3-4g of iron, more than half of which is in the form of hemoglobin responsible for the transport of oxygen from lungs to the tissues. Iron is also a constituent of a number of enzymes. (11). Plasma level of iron (Fe) was reported significantly lower in vivax malarial patients, whereas, in our study the serum iron levels decreases 2.0708 in vivax malarial patients. It is decreased in malaria patients due to digestion of hemoglobin by malaria parasites.

The variation in Mg levels in malaria is controversial in some study Mg levels is shown depleted and in some study there is an elevated of Mg levels in serum. In order to verify this controversy the present study was carried out, our results in figure 2(a) shows reduced mean values of magnesium levels in blood serum, as the recent research has proven that the magnesium is also a cofactor to the enzyme creatine kinase, which converts creatine into creatine phosphate or phosphocreatine (which is the storage form of creatine). Depletion in Mg levels with reduces the function of conversion of creatine into creatine phosphate. Increase creatine levels will develop nephropathy. Since creatine monohydrate supplements are extremely popular and proven to be effective, magnesium may be an important mineral help optimize creatine function. (12). Many signs symptoms of malaria occur due to the magnesium deficiency (13). The concentration of serum magnesium level increase in falciparum malaria (14) where the magnesium serum levels to be 12.2467 in vivax malarial patients decreases. The results suggest that the Mg deficiency is related to the decrease in erythrocyte (15). Figure 2 (b) shows the mean values of Zinc, which shows decreased levels. Concentration of serum levels of zinc (Zn) was reported significantly lower in vivax malarial patients (4) in our study similar results were obtained and shows decreased 4.9017 mean values of zinc serum levels in malarial patients as compared to control subjects.

The role of serum trace metals in malaria is not clear understood. In this study, we have shown that the metals such as copper, iron, magnesium, and zinc in human body may vary in malaria. Where results obtained were compared with those of the control subjects.

In this study the metal content of copper, iron, magnesium and zinc in vary in malarial patients as compared those in the normal subjects. The study was carried out using Atomic Absorption spectrometer, the serum levels of copper increased whereas, metals iron, magnesium, and zinc shows decreased levels in blood serum of malarial patients as compared to the normal subjects. It suggests that the decreased levels of iron, magnesium, and zinc can be maintained by given supplement of these metals as therapy.

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The authors declare that there is no conflict of interests.

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