

Serum Copper, Zinc, and Magnesium in Toxoplasma-Seropositive Women with a History of Abortion

Nada M. Al-Basheer

Medical Research Center, College of Medicine, Al-Nahrain University

Yahya Y.Z.Farid

Department of Chemistry and Biochemistry, College of Medicine, Al-Nahrain University.

Hussein K.A.Hussein

Head of Department of Chemistry, College of Science, Karbala University.

Huda Thaher hathal

Medical Research Center, College of Medicine, Al-Nahrain University

Correspondence to: Dr.Hussein Kadhem Abdul Hussein, Department of Chemistry, College of Science, Karbala University. E-mail: headm2000@yahoo.com

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Abstract

Toxoplasmosis has a high prevalence rate of infection in different countries of the Arab world including Iraq. Trace elements such as copper (Cu), zinc (Zn), and magnesium (Mg) have an important chemical and biological roles and may changed in different diseases. The aim of this work is to study the correlation of the mode of changes in serum Cu, Zn, and Mg concentrations and the infection by *Toxoplasma gonadii* in (IFAT) seropositive women.

Two hundred Iraqi women who have frequent abortion and their sera are positive in toxoplasmosis test (IFAT) in addition to 100 women for controls (who have no abortion) were participated in this study. Serum Cu, Zn, and Mg were determined by the atomic absorption spectrophotometry.

The results of this study revealed that serum copper was markedly elevated ($p < 0.05$) and serum zinc was significant decreased ($p < 0.05$) in Toxoplasmosis-seropositive women as compared with control. While there is no significant difference in serum magnesium in the patients group as compared with control.

There are different modes of changes in the serum level of Cu, Zn, and Mg in patients as compared with normal controls and these modes are explained according to the immunity response.

Key words: Toxoplasmosis; abortion; trace elements; copper; zinc; magnesium.

الخلاصة

يعتبر داء المقوسات ذو نسبة انتشار عالية في الاقطار المختلفة في العالم العربي ومن ضمنها العراق. تعتبر العناصر الضئيلة في الجسم مثل النحاس و الزنك و المغنيسيوم من المواد ذات الأهمية من الناحية الكيماوية و الحياتية وقد وجدت أنماط متنوعة من التغيير في تركيز هذه العناصر في الامراض المختلفة. تهدف هذه الدراسة إلى دراسة العلاقة بين انماط التغيرات المحتملة في مستويات النحاس و الزنك و المغنيسيوم في المصل و الإصابة بمرض داء المقوسات.

اشترك في هذه الدراسة ٢٠٠ امرأة من اللواتي لديهن اجهاضات سابقة و مصولهن تعطي كشف موجب عن المرض بكشف (IFAT) عن مرض داء المقوسات واخذ ١٠٠ امرأة سليمة من المرض (ليس لديهن اجهاضات سابقة) لغرض المقارنة. تم قياس تركيز النحاس والزنك و المغنيسيوم في المصل بتقنية الامتصاص الذري. أظهرت النتائج أن ارتفاع معنوي في تركيز من النحاس في المصل بينما يوجد انخفاض معنوي في تركيز الزنك في المصل عند مرضى داء المقوسات مقارنة بالنساء السليمات. لا يوجد هناك تغيير معنوي في تركيز المغنيسيوم في المصل عند المرضى مقارنة بمجموعة السيطرة.

توجد اختلافات في مستويات العناصر الضئيلة النحاس والزنك التي درست في مصل مرضى داء المقوسات عند مقارنتها بالنساء غير المصابات وشرحت هذه التغيرات استنادا إلى الاستجابة المناعية للمرض.

مفاتيح الكلمات: زنك، مغنيسيوم، نحاس، الحامل، مصل، العناصر الضئيلة.

Introduction

Toxoplasma gondii is an obligatory intracellular protozoa parasite with a world-wide distribution which is capable of infecting all worm-blooded animals and is of both medical and veterinary importance. Felids are the only known definitive host for toxoplasmosis, in which infection lead to sexual replication in intestinal epithelial cells, resulting in the shedding of millions of oocysts ⁽¹⁾.

The diagnostic is exclusively based in the detection of serum specific antibodies (IgG, IgM, IgA, IgE) and more recently, in the avidity of serum IgG ⁽²⁾.

The infection is generally asymptomatic for healthy individuals; it may lead to

serious inflammations such as chorioretinitis or encephalitis, and occasionally death through reactivation of encysted parasite in immune deficient host like patients with acquired immune deficiency syndromes (AIDS) ⁽³⁾. Toxoplasmosis is caused by a protozoal parasite that can be found in dried cat feces, contaminated soil, or contaminated water; and raw or undercooked meat containing infective tissue cysts. Although cats play a role in the epidemiology of the disease, there is no statistical correlation between toxoplasmosis infection and cat ownership. Toxoplasmosis can be transmitted to the fetus in utero through transplacental transmission ⁽⁴⁾.

Toxoplasmosis has a high prevalence rate of infection in different countries of the Arab world including Iraq ⁽⁵⁾. Al-saffer (1979)⁽⁶⁾ recorded the first cases of abortion in Iraqi women ,who were recognized to be infected with toxoplasma in a rate of 46.5 %, and with an increase in the percentage of infected women, in recent years, Al-Dujaily (1998)⁽⁷⁾ reported an infection rate of 34.7% among pregnant women in Baghdad in comparison with 3% reported by Tawfiq (1983)⁽⁸⁾.

Trace element play an important role in biological processes through their action as activators or inhibitors of enzymatic reaction, or by influencing the permeability of cell membrane, or by its essential role of direct anti-oxidant enzyme ⁽⁹⁻¹¹⁾ so in this study we tried for the first time to evaluated the relationships between the parasitic infections disease and the level of trace elements in blood or sera of aborted toxoplasmosis seropositive women.

Materials and Methods

Patients: Two hundred Iraqi women who have frequent abortion and their sera were positive in toxoplasmosis test (IFAT) in addition to 100 women for control (who have no abortion) were participated in this study. These cases were collected from

different hospitals in Baghdad city. All patients were examined by the senior gynecologist, and referred to the Central Public Health Laboratory for toxoplasmosis test. The age of these women were ranged from 15-45 year. Venous blood samples were collected from patients before taking any medications. Sera were separated and stored at (-20°C) until analysis.

Assay for serum metals: One hundred microliters of serum diluted into total volume of 1ml using 6% n-butanol solution and analyzed for their copper and zinc contents using atomic absorption spectrophotometer (Shimadzu AA-646) using copper and zinc hollow cathode lamps at wavelengths of 324.75nm and 213.9nm respectively. The assay for magnesium estimation was carried out by adding 4.9ml of (1% lanthanum chloride) solution to 0.1ml of serum. These solutions were aspirated directly into air-acetylene flame and the magnesium hallow cathode lamp were used at wavelength 285.2nm.

Serum ceruloplasmin: Ceruloplasmin activity in the sera was determined in this study according to the method of Monden *et al* (1977) ⁽¹²⁾, which is based on the ceruloplasmin catalyzed oxidation of the colorless P-

phenylenediamine to blue-violet colored Branawiski base⁽¹³⁾.

Statistical analysis: The results were analyzed statistically, and values were expressed as (mean $\pm$ SED). The level of significance was determined by employing (t) test. Only when the p-value was less than 0.05; the difference between two groups considered statistically significant.

Results and Discussion

The results of serum Cu, Zn, and Mg in patients with toxoplasmosis and normal controls are presented in Figure (1). Serum copper showed a significant increase at ($p < 0.05$) in patients as compared with healthy controls. These results also associated and confirmed by the parallel increase in serum ceruloplasmin of the patients in comparison with controls as shown in Figure (2).

Ceruloplasmin had been widely used as a measure of acute phase reactivity. During inflammatory states, it acts as an antioxidant through either prevention of decompartmentized iron acting as free radical catalysis or by directly inactivating the free radical⁽¹⁴⁾. In one research, decreased levels of serum copper could be used as a method of choice for detecting infection during the first trimester of pregnancy⁽¹⁵⁾.

Many investigators were observed an elevation in the liver enzymes (ALT, AST & LDH) in the sera of patients with toxoplasmosis⁽¹⁶⁻¹⁷⁾. Levels of these enzymes in blood reflect the occurrence of liver damage or muscle damage. This is the other cause for increase copper level in serum due to shedding the copper from the injured hepatocells⁽¹⁸⁾.

Serum zinc showed a decrease at ($p < 0.05$) as compared with healthy controls as shown in Figure (1). Zinc is a metal essential for maintaining the integrity of immune system⁽¹⁹⁾. The results showed that the specific cellular immunity is detectable in virtually all Toxoplasma-infected patients, including newborns⁽²⁰⁾.

In the animal field, *T. gondii* infection caused a significant decrease in the total number of white blood cells, reticulocytes and platelets. However, the relative proportion of granulocytes and lymphocytes was changed in favor of granulocytes, as compared to pre-infection levels. The functional activity of granulocytes was also increased. These changes may reflect the changes in the distribution of the metals between extracellular and intracellular fluids⁽²¹⁾.

The underlying requirement of zinc in maintaining immunocompetence requires further study, but may be a

result of its requirement in many enzyme systems, or its ability to stabilize biologic membrane⁽¹⁹⁾. Several laboratories have found that zinc deficiency depresses antibodies responses possibly owing to a loss of T-helper-cell function⁽²²⁾. Zinc deficiency affects the biological activity of thymus hormones and has a major effect on cell mediated immunity perhaps as a result⁽²³⁻²⁴⁾. Zinc is the most important trace elements for immune function and its deficiency is associated with immune abnormalities and increase susceptibility to infectious diseases. The effect of zinc added diet on cellular immunity in toxoplasmosis was investigated in rats and found that zinc diet in toxoplasmosis stimulated the cellular immunity, increased CD8 the total lymphocytes⁽²⁵⁾.

In zinc deficiency, the function of leukocytes is impaired. It is difficult to determine whether the decrease in serum zinc is the result of a real or an apparent zinc deficiency. In stress, which is present in women with frequent abortion, the decrease of zinc reflects an apparent zinc deficiency because of redistribution of serum zinc into the liver and because of decrease in serum albumin concentration where

over 70% of the serum zinc is bound to albumin⁽²⁶⁾.

The mean serum magnesium of patients with toxoplasmosis is statistically unchanged in comparison with that of healthy controls. Magnesium level is normally kept within narrow limits, which implies close homeostatic control⁽²⁷⁾.

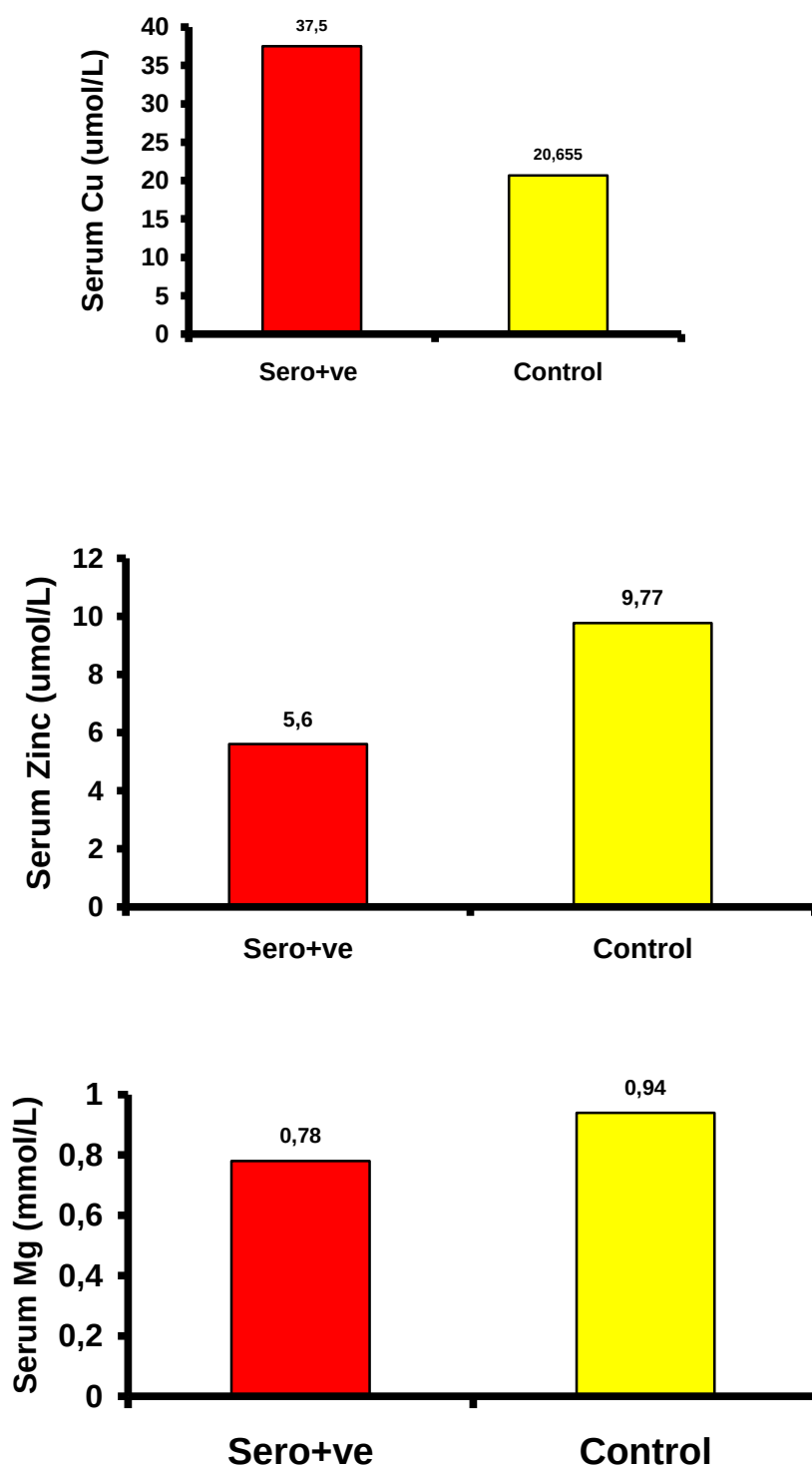


Figure (1): Serum Cu, Zn, and Mg in toxoplasmosis-seropositive women and control.

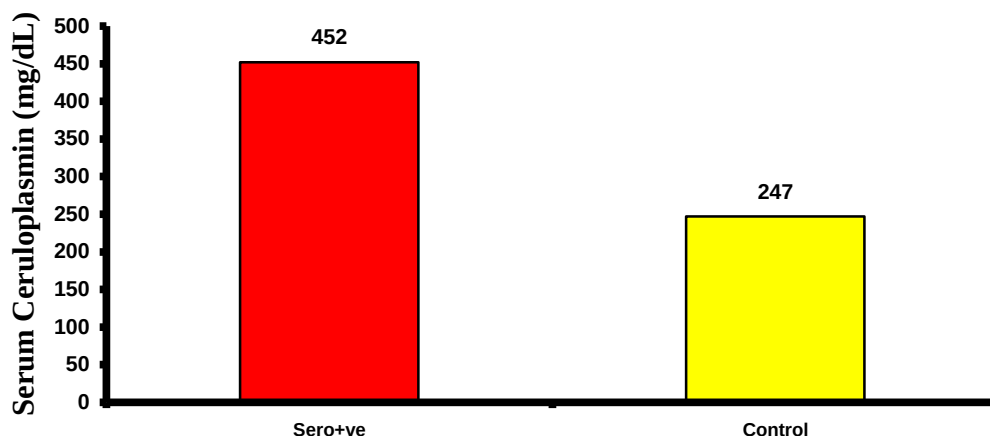


Figure (2): Serum ceruloplasmin in toxoplasmosis-seropositive women and control.

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