

Levels of Magnesium, Zinc, Calcium and Copper in Serum of Patients with Fibromyalgia Syndrome

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ABSTRACT:

BACKGROUND:

Fibromyalgia syndrome (FMS) is a chronic musculoskeletal syndrome; almost invariably, symptoms persist at 5- and 10-year follow-ups. Several studies reported the importance of trace elements on the immune system. It plays an important role in physiological processes that are crucial for normal functioning of the immune system. Fibromyalgia could be the result of an over-active immune system, the immune system works to protect the body by attacking bacteria, viruses, and other foreign cells. When over-active, the immune system can cause severe inflammation and pain.

OBJECTIVE:

The main objective of this study is the association between the levels of Magnesium, Zinc, Calcium and Copper in patients with FMS.

PATIENTS AND METHODS:

This study was performed during the period from April 2009 to February 2010, and included 60 patients with FMS according to the ACR 1990 criteria, these criteria, a history of widespread pain has been present for at least three months affecting all four quadrants of the body, i.e., both sides, and above and below the waist, and there are 18 designated possible tender or trigger points. During diagnosis, four kilograms-force (39 newtons) of force is exerted at each of the 18 points; the patient must feel pain at 11 or more of these points for fibromyalgia to be considered. Four kilograms of force is about the amount of pressure required to blanch the thumbnail when applying pressure. Their age range was from 20-60 with the mean age of 39.95 ± 1.10 years. These patients were matched by age and sex to 30 healthy control subjects with the mean age 42.81 ± 2.16 years. Blood samples were taken from each individual and separated for the estimation of Mg, Zn, Ca and Cu levels using atomic absorption technique. The laboratory tests were done in Teaching Laboratories of the Medical City and the Department of Physiological Chemistry / College of Medicine University of Baghdad.

RESULTS:

The level of Mg, Zn and Ca in serum of patients with FMS was significantly lower than in serum of healthy control while the level of Cu in serum of FMS patients was significantly higher than healthy control.

CONCLUSION:

Levels of Mg, Zn, Ca concentrations in serum of patients with FMS were significantly lower than healthy control subjects, while Cu concentration in patients with FMS was significantly higher than healthy control subjects and levels of Mg, Zn, Ca and Cu may be a good indicator to evaluate this disease.

KEYWORD: Mg, Zn, Ca, Cu and fibromyalgia syndrome

INTRODUCTION:

Fibromyalgia is a chronic condition causing pain, stiffness, and tenderness of the muscles, tendons,

and joints. Fibromyalgia is also characterized by restless sleep, awakening feeling tired, fatigue, anxiety, depression, and disturbances in bowel function. Fibromyalgia was formerly known as fibrositis.⁽¹⁾ There is no recognized cure for fibromyalgia, but some treatments have been demonstrated by controlled clinical trials to be effective in reducing symptoms, including psychological or behavioral therapies⁽²⁾, medications, patient education, and exercise⁽³⁾.

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Fibromyalgia syndrome affects 2-4 % of general population; and affects more females than males, with a ratio of 9:1 by ACR criteria, 80-90 % of the cases are women, usually in the childbearing age. Men, children, and elderly account for the remaining 10-20 % of cases⁽⁴⁾. Some patients⁽⁵⁾ with FMS may report difficulty with swallowing,⁽⁶⁾ bowel and bladder abnormalities⁽⁷⁾.

Magnesium is the fourth most abundant mineral in the body and is essential to good health. Approximately 50% of total body magnesium is found in bone. The other half is found predominantly inside cells of body tissues and organs. Only 1% of magnesium is found in blood, but the body works very hard to keep blood levels of magnesium constant and it is needed for more than 300 biochemical reactions in the body⁽⁸⁾.

Zinc is critical for the formation and activity of many enzymes and cells that play a role in the maintenance of a healthy immune system and has been used in the medical world for centuries and it is a component of more than 100 enzymes enumerate some of their at least 3 associated with many different metabolic processes, including the synthesis of the nucleic acids RNA and DNA⁽⁹⁾. Calcium is one of the most important elements in the diet because it is a structural component of bones, teeth, and soft tissues and is essential in many of the body's metabolic processes. It accounts for 1 to 2 percent of adult body weight, 99 percent of which is stored in bones and teeth. Calcium is also essential for proper blood clotting, and has a key role in the physiology of muscular contraction. Changes in calcium ion concentration may be involved in the pathogenesis of fibromyalgia⁽¹⁰⁾.

Copper is essential in all plants and animals. The human body normally contains copper at a level of

about 1.4 to 2.1 mg for each kg of body weight. Copper is transferred by albumin across the gut wall and carried to the liver where it is formed into ceruloplasmin, a copper transport protein⁽¹¹⁾.

Deficiency in trace elements may take part in pathophysiology of fibromyalgia and it contributes to clinical symptoms. Trace elements such as selenium and zinc are essential for many antioxidant enzymes as cofactor⁽¹²⁾. Magnesium is a trace element, which plays a considerable role in ATP synthesis and it is important for adequate muscle metabolism. Reduction of blood flow and ATP beneath the tender points and local hypoxia are important factors in progress of patients with FMS⁽¹³⁾.

PATIENTS AND METHODS:

The prospective study comprised 60 Iraqi patients (50 female, 10 male) fulfilling the ACR criteria for the diagnosis of FMS. Their age range 20-60 years with mean age of 39.95.

Another 30 (22 female, 8 male) healthy individuals who are age and sex matched with the patients.

Blood samples were taken from individuals in both groups for estimating Mg, Zn, Ca and Cu levels.

Laboratory investigation which include: Hemoglobin (Hb), Erythrocyte sedimentation rate (ESR) were done in Laboratory Teaching Center of Baghdad Hospital.

The study was based on the concept of atomic absorption technique and based on the phenomenon of absorption of radiation by free atoms of elements. Atomic absorption spectrometry is used for determination of micro-samples of metals in different matrices.

All serum proteins were precipitated by addition of equal volume of 1.2 TCA, after centrifugation, several dilutions of supernatant was made before the determination of the free ions of the elements by the atomic absorption spectrophotometer.

The concentration of the elements was calculated according to the following equation:

A_{sample}

Conc. of element ($\mu\text{g/ml}$) =

$$\frac{X \text{ standard conc.}}{A_{\text{standard}}}$$

A_{sample} = Absorption of sample

A_{standard} = Absorption of standard

Conc. = concentration

Statistical analysis:

Descriptive statistics for all data of each set were expressed as a mean \pm SD, and compared using independent sample (t) test $p < 0.05$ were considered

statistically significant. The overall productive values for the results in studied groups were performed according to program of office xp.

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RESULTS:

The characteristics of both FMS patients and controls are shown in table (1).

The mean values of Mg and Ca concentrations in serum of patients with FMS were significantly lower as compared to the level in serum of healthy

controls ($p < 0.01$) and the mean value of Zn concentration in serum of patients with FMS was significantly lower than the control ($p < 0.05$). While the mean value of Cu concentration in serum of patients with FMS was significantly higher than the control ($p < 0.01$) as shown in Table 1.

Table 1: Statistical Data for Mg, Ca, Cu and Zn concentrations in serum of patients with FMS and healthy control.

Trace element	Patients (N=60) Mean \pm SD	Control (N=30) Mean \pm SD	t-test (P-value)
Mg (mg/dl)	1.135 \pm 0.173	1.687 \pm 0.274	0.001
Ca (mg/dl)	8.417 \pm 0.823	9.373 \pm 0.572	0.001
Cu (μ g/dl)	170.83 \pm 13.06	115.93 \pm 15.57	0.001
Zn (μ g/dl)	95.00 \pm 8.69	111.00 \pm 10.62	0.04

Mg = magnesium
Ca = calcium
Cu = copper
Zn = zinc
FMS = fibromyalgia syndrome
SD = standard deviation
N = number of samples

DISCUSSION:

Magnesium ion plays a key role in the physiology of muscular contraction / relaxation and general muscle health. Also Mg is needed for over 200 biochemical reaction in the body, including energy production and muscle tissue repair.

Results of this study agree with other studies⁽¹⁴⁾. The intravenous ketamine test predicts subsequent response to an oral dextromethorphan treatment regimen in fibromyalgia patients⁽¹⁵⁾, which found also that the level of serum Mg was significantly lower in patients with FMS than the healthy control and there was meaningful association between the level of serum Mg and fatigue.

So according to the result of this study, it asserted that serum Mg may play an important role in the pathophysiology of FMS. Since Mg deficiency may lead to lower level of sleep hormone melatonin, decreased immune function, increased inflammation and loss of glutathione (an important antioxidant and detoxificant produced by the body). Mg can also help tiredness, fatigue, sleep disturbance, muscle stiffness, pain, anxiety, depression and headaches⁽¹⁶⁾.

Calcium ions have a key role in the physiology of muscular contraction. Changes in calcium ion concentration may be involved in the pathogenesis of fibromyalgia⁽¹⁵⁾.

Fibromyalgia seems to be associated with osteoporosis. A large percentage of fibromyalgia

patients suffer from decreased bone mass because of the decreasing in Calcium concentration leading to bone fractures. Calcium enhances the body's cartilage repair function and stimulates collagen production. It also optimizes the cartilage matrix⁽¹⁷⁾.

A study from Dr. Russell's group show that the level of Zinc found in the blood is known to be related to pain in animals. This study sought evidence to implicate Zinc in the mechanism of fibromyalgia pain in humans. Association between serum zinc level and number of tender points was found as high significant ($P = 0.008$). According to the results of this study, it was asserted that serum Zinc levels may play an important role in the pathophysiology of FMS⁽¹⁸⁾.

Results obtained in the present study showed that the level of Cu in serum of FMS patients was significantly higher than the healthy control, which agree with other studies⁽¹⁹⁾ of Dr. Paul C. Eck, who showed in their study that a patient suffers from headaches, fatigue, insomnia, depression, skin rashes, spiciness, can be symptoms of a Copper imbalance. These imbalances can contribute to osteoporosis and bone spurs, also copper is required to fix calcium in the bones and to build and repair all connective tissue. Copper has a number of important functions in the human body. The problem usually occurs when there is too much of it in the soft tissues of the body⁽²⁰⁾.

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Also toxic metal accumulation may contribute to some cases of fibromyalgia. Among the most commonly seen is copper toxicity⁽²⁰⁾.

CONCLUSION:

The levels of Mg, Zn, Ca concentrations in serum of patients with FMS were significantly lower than healthy control subjects, while Cu concentration in patients with FMS was significantly higher than healthy control subjects and levels of Mg, Zn, Ca and Cu may be a good indicator to evaluate this disease.

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