Evaluation of serum magnesium, zinc, copper and ascorbic acid levels in patients with hypertension and atherosclerotic heart diseases

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In this study, serum magnesium, zinc, copper and ascorbic acid were studied in 60 subjects with atherosclerotic heart disease (AHD), 60 patients with hypertension, 30 patients who had atherosclerotic heart disease with hypertension and 80 healthy controls.

Mg levels were significantly lower in all there study groups compared with controls ($p<0.001$); however, Cu levels were significantly higher in all three study groups compared with controls ($p<0.01$). Zn levels had no statistical significance compared to controls.

AHD group and AHD with hypertension group had significantly lower ascorbic acid levels compared with controls ($p<0.01$). However, the difference found in the hypertensive group wasnotstatistically significant ($p>0.05$).

Besides the functional and biochemical risk factors we conclude that Mg, Zn, Cu levels and ascorbic acid deficiency may have an important role in pathogenesis of hypertension and AHD.[Turk J Med Res 1993 11(6): 273-276]

Key **Words:** Magnesium, Zinc, Copper, Ascorbic acid, Hypertension, Coronary arteriosclerosis

Coronary atherosclerotic heart disease is the most significant factor causing natural death in industrialised countries. During the last 60 years a progressive increase is observed in the incidence of this disease. It is known that environmental pollution caused by industrial development leads to a deposition of same metals in the body or it causes a deficiency of same excessively refined nutrients which are essential to our body. Hypertension is one of the significant risk factors of AHD.

Mg is one of the metals, the deficiency of which causes atherosclerosis. The importance of magnesium here is intended to be explained that it stimulates oxidative phospharilation in heart, it affects Na, K, ATP in the membrane of heart, and it activates adenilcyclase in the heart (2-4). Mg exists in many of the biological systems where ATP is used and energy is required. These are the activities such as amino acid activation, acetate generation and transmission, muscle contraction. Mg is important in normal brain function, and it plays an important role in the transportation of Na and K from cell membrane (5-7).

The functions of zinc can be summed up in 4 basic groups such as its role in enzyme systems, and in protein synsthesis, its effect on carbonhydrate metabolism and its relations with endocrine system (9-14).

The signs of Zn deficiency are growth retardation, weakening, shortness in body height, hypogonadism, failure in smelling and tasting, mental lethargy, lessening in activity, changes on the skin and hepatosplenomegali (9-14).

Copper, which is a component of many enzymes containing copper, plays role in lots of physiological functions in men and animals. These functions of Cu are related with the enzymes by which it is contained, and the clinical findings found out in its deficiency or excessiveness will serve to explain it. These enzymes are as follows: Cerulopasmin, monoaminooxidase, superoxide dismutase, ascorbic acid oxidase and amino levulinat dhydratase (10,16,18).

Ascorbic acid, known as antiscorbutic factor as well, has the functions such as collagen production of ascorbic acid in organism, oxidoreduction incidents, formation of energy, biosynthesis of steroid hormones folic acid synshesis, active phagocytosis, eritropoesis,

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Table 1. Serum magnesium, zinc, copper and ascorbic acid in control and patient groups (X±SEM)

	Mg (mg/dl)	Zn (M9/dl)	Cu (M9/dl)	Ascorbic Acid (mg/dl)
CONTROL	1.96+0.15	137.7±21.8	120.86±20.3	0.65±0.16
APD	1.73±0.17 p<0.001	131.6±20.2 p>0.005	136.33±23.9 p<0.01	0.54±0.12 p<0.01
HYPERTENSION	1.79±0.17 p<0.001	132.4+19.3 p>0.05	135.08±23.0 p<0.001	0.64+0.19 p>0.05
AHD +HT	1.74±0.18 p<0.001	137.2±20.1 p>0.05	135.43±20.2 p<0.001	0.57+0.27 p>0.01

and in addition to those functions of it, its relation with coronary heart disease, asthma, and cold has increased its currency. It is noteworthy that a decline in heart disease is observed in those having an intake of ascorbic acid (19,20).

This study has been carried out to survey the importance of Mg, Zn, Cu and vitamin C in the patients with hypertension and atherosclerotic heart disease.

MATERIALS AND METHODS

This study was carried out on a total of 150 patients, 60 of whom had AHD, 60 had hypertension, 30 had AHD-hypertension, and 80 subjects were in the control group.

It was taken in to consideration in choosing the subjects that the patients with atherosclerotic heart disease and the groups with hypertension were carrying the risk factors required. The patients had a complaint of angina pectoris. Additionally, same applications, which clinically support the diagnosis, such as measuring the blood pressure, ECG and effort test were carried out on the patients. The patients with early infarctus were not included in the study due to the homogenbyity of the group.

The blood samples obtained from the subjects were centrifuged (15 minutes at 3000 g) and they were separated from serum, and soon after, their ascorbic acid determination was performed by Lowery-Lopez, Bessey method (21).

For magnesium, zinc and copper the blood samples, which were taken in to the tubes washed by distilled and deionised water for 3 times, were kept in -20 °C after their serum was separated. Measurements were performed by using "Hitachi Model 180-70 Polarized Zeeman" atomic absorbtion spectrophotometer. For each sample, the averages of 3 separate values were taken. In statistical evaluations, variance analysis was used together with Tukey-W test (22).

RESULTS

In our study, magnesium values were found significantly lower in the groups of patients compared to the control group ($p<0.001$). Zinc values were lower in the control group but no difference was observed statistically.

Serum copper levels in the group of patients were found significantly higher than that of the control group ($p<0.001$).

Ascorbic acid levels were found significantly lower in the AHD group, and in AHD with hypertension group (AHD+HT) compared to the control group ($p<0.01$), whereas there was no significant difference in the hypertension group ($p>0.05$) (Table 1).

DISCUSSION

Atherosclerosis seems to be the disease of our age due to its well known clinical properties and frequency for years. Nowadays atherosclerosis does not develop from a single and a certain cause, but several risk factors are mentioned correlated with its development. One of these risk factors and the most important one is hypertension. Among the suppositions suggested to explain the prevalance of this disease, the motly accepted ones, were nutrition, particularly the content of cholesterol on diet, sugar, the hardness or mildness of drinking water, phsical-exercise, consuming fibrous vegetables, and such are the subjects which are said to play positive or negative roles in ADH pathogenes (23,24).

In this study, significantly lower magnesium values ($p<0.001$) were found in the three groups of patients compared to the control group.

Magnesium deficiency causes degeneration in myocardium, infiltration, inflammatory cell deposition in acute period, alterations resulting in necrosis in some parts, breaking up in fibrils, nucleolus lose and vascular endothelium edema (25). Magnesium alters the generation of potassium into the cell through membrane ATP. QT interval elongation in magnesium deficiency possibly arises from the incomplete membrane transportation of potassium (26).

Deficient or excessive metal intake can cause the development of coronary heart disease. Magnesium deficiency plays a role to a small degree in hyperlipidemia development and arterial lesion. A relationship exists between serum magnesium level and

arterial lesion. There is a relationship between serum magnesium level and ventricular discharge (27). It has been possible that lower magnesium value can be corrected by treatment in the cases with heart disease (4). Magnesium plays an important role in electrophysiology of heart and in the formation of cardiac arythmias (4,26,27).

Magnesium deficiency is also effective in hypertension, and the increase in hipomagnesemia causes potassium loss (28).

Blood pressure is affected by many factors. According to the information obtained, magnesium can play an important role in preventing and controlling hypertension. There are epidemiological studies which indicate the existence of an inverse ratio between magnesium intake and hypertension, and parenteral magnesium sulphate treatment has been defined being succesful in lowering the hypertension of preeclampsia (29).

As a result it can be said that magnesium plays an important role in blood pressure and there might be magnesium deficiency in hypertension.

in our study we obtained statiscally insignificant zinc values though they were low in the group of patients compared to the control group ($p>0.05$).

This element which plays an important role in curing the wounds is said to have a lower level in the serum in the localized tissue damage (30). Zinc level tends to be lowered in coronary heart diseases (27). In particular, during the first 24th-48th hours of myocardial infarction it is stated that zinc level comes down, later on it acquires its normal level (31).

In a study carried out on various age groups, it was emphasized that zinc level comes down in those using diuretics due to zinc discharge through kidneys (28). Zinc can be a preventing factor for hypertension and atherosclerotic heart disease (32).

In conclusion, zinc levels in AHD, the difference of which was found low by same researchers and insignificant by same researchers, are accepted that in general they fall down during tissue damaging stages and in myocardial infarcts.

In our study, copper levels were found higher in the groups of patients compared to the control group ($p<0.001$).

Researchers have claimed that copper level goes up in severe heart disease; copper level was found higher in smokers; they have remarked that excessive intake of the elements such as cadmium and copper, cardiovascular mortality, regional differences are also important (27).

The oxidation of the stared lipids in serum and artery initiates atherosclerosis, for this reason, copper, a good oxidation catalyzer, is found high (31).

Copper level rises in the elderly patients with hypertension (28). We suggest that magnesium, zinc, and copper should be studied more extensively in atherosclerosis and hypertension, and these studies should be carried out until the time actual causes are found out.

In our study, ascorbic acid was found significantly lower in AHD group than that of the AHD group having hypertension ($p<0.01$), and in hypertensive group no statistical difference was found ($p>0.05$).

Vallance et al. found the levels of leucocyte ascorbic acid significantly lower and the number of high in the studies they carried out on the patients with acute myocardial infaistion. Although they observed a decrease at the level of leucocyte ascorbic acid on the 31 footballers who were subjected to heavy exercise, but they observed no fall at the serum ascorbic acid levels (33). In another study, a decrease was observed at the cholesterol level on giving high dose ascorbic acid in the cases with hypercholesterolemia (34).

As a matter of fact, no studies were found indicating ascorbic acid values in hipertensión. We obtained lower values in the patients, the difference was not significant. Ascorbic acid might also be effective in the pathogenesis of hypertension due to a close relationship between ADH and hypertension.

Ascorbic acid can play a role in preventing the atherosclerosis and in the treatment of acute myocardial infarction. The fall at the ascorbic acid level causes a noticeable decrease in the catabolism of cholesterol. It has been stated that one gram of ascorbic acid intake per day caures a noticeable decrease at the serum cholesterol level in the young people. Researchers have mentioned that there is a negative relationship between ascorbic acid and cholesterol level (35-37).

As a result, it has been concluded that hypovitaminosisc (hypovitaminosis C) can cause hypercholesterolemia in men, and it can play a role in the pathogenesis of atherosclerosis.

Hipertansiyonlu ve aterosklerotik kalp hastalarında serum magnezyum, çinko, bakır ve askorbik asit düzeylerinin değerlendirilmesi

Bu çalışmada 60 hipertansiyonlu, 60 aterosklerotik kalp hastası (ASKH), 30 hipertansiyonla birlikte seyreden aterosklerotik kalp hastası ve 80 kişiden oluşan kontrol grubunda serum Mg, Zn, Cu ve askorbik asit düzeyleri araştırılmıştır.

İstatistiksel değerlendirmede Mg her üç hastalık grubunda kontrol grubuna göre önemli derecede düşük ($p<0.001$), Cu önemli derecede yüksek ($p<0.001$), Zn ise farksız bulunmuştur.

Kontrol grubuna göre ASKH'lı grup ile hipertansiyonla birlikte seyreden ASKH'lı grupta askorbik asit önemli derecede düşük (p<0.01), hipertansiyonlu grupta ise istatistiksel olarak farksız (p>0.05) bulunmuştur.

Hipertansiyon ve A'SKH'nın patogenezindeki birçok yapısal ve biokimyasal olaylarda bilinen risk faktörlerine ek olarak Mg, Zn, Cu gibi element dengesizlikleri ile askorbik asit eksikliğinin de rolü olabileceği kanısına varılmıştır. [Türk J Med Res 1993; 11(6):273-276]

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