PLASMA AND ERYTHROCYTE LEVELS OF TRACE ELEMENTS IN HEALTHY ELDERLY

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ABSTRACT

The purpose of the investigation was to assess magnesium (Mg), zinc (Zn) and copper (Cu) concentrations in plasma and erythrocytes of healthy elderly individuals. The study covered 20 subjects aged over 80 years and 32 healthy individuals below 60 years of age. The levels of the trace elements were measured with atomic absorption spectrophotometry by using AAS-3030 B Perkin Elmer spectrophotometer. The data showed normal plasma and erythrocyte concentrations of Mg in healthy elderly. Plasma Cu level was higher while intraerythrocytic Cu showed the opposite tendency of a significant decrease in the group over 80 years (80-89 years) in comparison to controls (11,35±5,30 μmol/L versus 16,75±5,60 μmol/L). Plasma Zn was within normal limits with a slight tendency of decreasing while erythrocyte Zn was significantly lower in both elderly groups in comparison to controls: in 80-89 year-old patients of 158,14±43,79 μmol/L and in 90-102 year-old ones of 150,00±23,85 μmol/L versus 230,70±51,39 μmol/L in the controls. Our data demonstrate that the estimation of intraerythrocytic levels of Cu, Zn and Mg gives us more important information about their actual status and indicates a deficiency of Cu and Zn in old subjects. We recommend food enrichment with Zn even in healthy elderly individuals.

Key words: copper, magnesium, zinc, erythrocytes, plasma, elderly

INTRODUCTION

The role of trace elements in the process of aging is not completely revealed. One of the components of the antioxidant system includes zinc (Zn) and copper (Cu) as ingredients of the enzyme superoxide dismutase (SOD) and this proposes participation of these elements in aging. Man’s immune system, the action of some hormones and over 200 enzymes are Zn-dependent. The insufficient Cu also reflects mainly on the cells and causes predominantly hematological disturbances connected with the reduced activity of Cu-containing enzymes (6,7).

Magnesium (Mg) is an important intracellular ion which activates a large number of enzymes, acts in the regulation of energy metabolism and in supporting K/Na membrane gradient. The development and progression of atherosclerosis, hypertension, heart and psychological disturbances and osteoporosis in Mg-deficiency opens the question of the possible role of this trace element in the aging process for discussion (11). More significant information can be obtained about the active status of these elements by examination of their erythrocyte concentrations rather than of their plasma levels. Possibly, this is due to the fact that they take part in the enzyme processes at molecular and cellular level. Sometimes, if we ignore their important role and examine their plasma concentration only, we should conclude facts that are controversial to their active intracellular status.

The aim of this study is to examine the concentrations of Mg, Cu and Zn in plasma and erythrocytes in healthy elderly individuals aged over 80 years and their changes with aging.

MATERIAL AND METHODS

We examined the concentrations of Mg, Cu and Zn in plasma and erythrocytes in 20 elderly individuals (7 men and 13 women) aged 80-102 years (Table 1), living in a nursing home without evidence of renal diseases, hypertension, diabetes mellitus and hypercholesterolemia. The re-
results were compared to the plasma levels of these trace elements of a control group of clinically healthy subjects aged 20-60 years (1). Mg, Cu and Zn in both plasma and erythrocytes were measured with atomic absorption spectrophotometer AAS-3030 B Perkin Elmer (3.9). Variation analysis (±SD) was applied for statistical data processing. The results were assessed with Student-Fischer t-coefficient with a statistically significant value of \( p < 0.05 \).

**Fig. 1.** Plasma-Mg concentrations are compared between two groups elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were

**Fig. 2.** RBC-Mg concentrations are compared between two groups elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if \( p < 0.05 \). P - NS

**RESULTS AND DISCUSSION**

**Magnesium**

We didn’t find any statistically significant differences in plasma Mg, neither between the two groups of elderly individuals - in 80-89 years old (0.830±0.281 mmol/L) and 90-102 years ones (0.777±0.154 mmol/L), nor in the control group of 20-60 years old (0.737±0.37 mmol/L) (Fig. 1). Erythrocyte Mg didn’t show any significant changes with aging - in the control group of 20-60 years old (1.575±0.43 mmol/L), in the group of 80-89 years old (1.818±0.266 mmol/L), and in 90-102 years ones (1.580±0.228 mmol/L), respectively (Fig. 2).

**Copper**

Plasma Cu increased with the age. The change was significant for the age group >90 years in comparison to controls (<60 years) - 19.44±3.31μmol/L and 15.30±3.12μmol/L (Fig. 3), respectively. Erythrocyte Cu showed a tendency towards a decreasing with aging. The difference was significant for the age group of 80-89 years in comparison to the

**Fig. 3.** Plasma-Cu concentrations are compared between two groups elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if \( p < 0.05 \). * \( P < 0.05 \) - C : A

**Fig. 4.** RBC-Cu concentrations are compared between two groups elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if \( p < 0.05 \). * \( P < 0.05 \) - B : A
control one - 11.35±5.30 μmol/L versus 16.75±5.60 μmol/L (Fig. 4), respectively.

**Zinc**

Plasma Zn in both groups of elderly people decreased as compared to that of the controls. However, this difference was statistically insignificant (Fig. 5). Erythrocyte Zn was significantly reduced in elderly individuals aged over 80 years; in 80-89 years old (158,14±43.79μmol/L) and in 90-102 years old (150,00±23.85μmol/L) in comparison to that in controls (230,70±51.39μmol/L). There was no significant difference of its erythrocyte levels between the two groups of elderly people (80-89 and 90-102 years old (Fig. 6).

![Figure 5](image)

**Fig. 5. Plasma-Zn concentrations are compared between two groups elderly patients (B and C) and control group young patients (A). Values are given as mean ± standard deviation. Significant differences were assumed if p<0.05. P - NS**

The examination of Cu, Zn and Mg plasma concentrations in healthy elderly individuals enables the assessment of the hypothesis if the aging influences on the homeostasis of the electrolytes and trace elements themselves (4). There are numerous studies in the literature available related to the establishment of the plasma levels of these elements. There are few reports dealing with the intracellular and, especially, with the intracellular concentrations of the trace elements and Mg (4,5,8). It is supposed that the needs of protective agents (vitamins and minerals) against the degenerative processes in elderly are higher. Del Corso et al. (4) determined the blood concentrations of Cu, Zn and Mg. Their results suggest that the healthy free-living elderly have had an adequate mineral intake and do not need any nutrient supplements. They may be useful in the elderly with chronic diseases. Actually, Wakamoto et al. (12) have found out higher serum concentrations of trace elements in ≥85 year-old subjects, especially of phosphorus and Zn. Our healthy elderly subjects aged over 80 years present with normal plasma and erythrocyte Mg, i.e. they are not Mg-deficient. They have not taken medicines that cause hypo- and hyper-magnesiemia and there is no evidence of Mg-resorption disturbances. Probably, these two reasons explain our results.

The elderly people are a risk group for Zn-deficiency. The risk for hypozincemia increases with aging (10). Prasad et al. (7) have established a low intake of Zn with food in elderly. In our subjects, plasma Zn is in normal range but tends to decrease, while erythrocyte Zn level in elderly is lower than in the control subjects. This emphasizes, possibly, the proper active status of this trace element. Opposite to Zn, plasma Cu is increased in elderly people aged over 75 years and correlates with the age (6). In case of insufficient nutrition there is a great reduction of plasma Cu (2). In our healthy elderly the tendency of increasing erythrocyte Cu with aging is outlined. On the other hand, the examination of erythrocyte Cu demonstrates the opposite trend - its decreasing with age.

The study of plasma Cu, Zn and Mg in healthy elderly gives the possibility of assessment of the hypothesis if aging influences on electrolyte and trace element homeostasis. The misbalance of these elements in the organism can not be disguised early because of the minimal plasma concentration of trace elements. If we have in mind their intensive action in the cellular processes, the examination of their erythrocyte level will allow a correct clinical evaluation of their metabolic status. We established normal plasma and erythrocyte Mg levels in the healthy elderly aged over 80 years. The plasma concentration of Zn was in the normal range but tended towards a reduction. Erythrocyte Zn in elderly aged over 80 years was significantly reduced in comparison to that of the control group and showed Zn-deficiency in these subjects. Plasma Cu increased with aging (significantly in the age over 90 years) while erythrocyte Cu showed a tendency of decreasing (significantly at the age of 80-89 years).
CONCLUSION

In our study the elderly individuals are clinically healthy subjects. There are no data about their disease or medication that would provoke deficiency. It is possible that our results are due either to aging itself, or to non-balanced nutrition. For this reason, we accept that even in healthy elderly aged over 80 years it is necessary to enrich the food with Zn.

REFERENCE


