BIOGERONTOLOGY

Macro- and Trace Element Status of Patients of the Elder Age Groups

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Serum concentrations of macro- and trace elements in patients of the elder age groups differ significantly from normal values and depend on the age and presence of pathologies.

Key Words: *elderly patients; macroelements; trace elements; cardiovascular diseases*

Despite low content of mineral elements in tissues, they are essential for the course of physiological processes. It was shown by modern methods that almost all elements present in nature can be found in human body, at least in trace amounts.

Many diseases are characterized by common (stress) and specific (qualitative and quantitative) elementograms. The specific elementogram can serve as an additional diagnostic and prognostic test. Metals are most informative for prenosological diagnosis, because they activate a substantial group of enzymes. Therefore, it is important to measure the content of mineral elements in various media [1].

MATERIALS AND METHODS

Blood sera of 117 patients (25 men and 92 women) aged 60-98 years were studied. The patients were hospitalized at clinical departments of Russian Gerontological Center for arterial hypertension (AH), coronary disease (CD), and chronic cerebral ischemia (CCI).

The concentrations of macroelements (calcium, potassium, sulfur, magnesium, chlorine) and trace elements (iron, zinc, copper) in serum specimens collected after overnight fasting before and after a course of treatment were measured by X-ray fluorescent analysis. After 10-min centrifugation, 500 μl serum was diluted with distilled water (1:1). The resultant fluid (100 μl) was pipetted into the center of a paper filter with an eicosane hydrophobic ring. The filter was then dried and X-ray spectral studies were carried out.

The intensity of X-ray radiation of 5 parallel samples was measured on a VRA-33 X-ray fluorescent analyzer using an X-ray tube with a silver anode at 28 kV and 40 mA current. The analytical signal was recorded in a vacuum spectrometer (0.6 Pa). In order to reduce the effects of rough surface of the radiation source, the sample was rotated. The duration of exposure was 90-300 sec. The concentrations of macro- and trace elements in the sample were determined by calibration curves. Calibration curves were plotted using samples of known composition and were linear for a wide range of the measured concentrations of elements [2].

The data were statistically processed using StatPlus and Excel software.

RESULTS

Reduced serum concentrations of iron, potassium, calcium, magnesium and elevated concentrations of zinc and sulfur were detected in patients of the elder age groups (Table 1). The concentration of

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copper surpassed the normal in elderly patients, progressively decreased with age, and was significantly below to the normal in the oldest patients (Table 1). Chlorine concentration negligibly differed from the normal in patients of all age groups (Table 1).

Serum concentrations of macro- and trace elements were analyzed in patients of elder age groups with consideration for gender. No appreciable gender-specific differences in serum macro- and trace element composition were detected in patients of the elder age groups.

Serum concentrations of macro- and trace elements were analyzed in patients with a history of instrumentally confirmed myocardial infarction and the data were compared with the values in patients without history of infarction. The concentration of iron was reduced significantly in patients with a history of infarction.

Progressive decrease in iron content during aging can be explained by reduced need in this element because of deterioration of tissue respiration and transcapillary metabolism, reduced intensity of protein synthesis processes regulated by iron-dependent and iron-containing proteins, and disorders in the absorption of this element in the intestine [8]. The more pronounced decrease in serum iron concentration in patients with a history of myocardial infarction is presumably caused by the formation of a defense mechanism protecting from repeated myocardial injury, because high iron level in the plasma is a risk factor for myocardial infarction [12].

Many diseases, including AH and CD, are associated with high serum levels of zinc-dependent and zinc-containing enzymes, which explains the detected increase in zinc concentration. The severity of CD progresses with aging, which also coincides with progressive increase of serum zinc level.

The increase of copper content in elderly patients (60-74 years) can be attributed to more intense antioxidant defense in response to LPO processes, becoming more active at this age. Progressive reduction of copper concentration with age corresponds to the degree of the defense impairment. The intensity of synthetic processes, regulated by copper-dependent enzymes, also decreases with aging, and hence, copper level decreases [11].

Serum potassium and calcium concentrations are reduced in patients of elder age groups, the lowest values being recorded in senile patients.

Calcium entry into the cell is accelerated in AH patients, while its release from the cell is inhibited, which can lead to a decrease in serum calcium concentration [7]. In our study, the highest blood pressure values were observed in senile patients with the lowest serum calcium levels. The lowest blood pressure was recorded in patients with the longest life span, who exhibited the highest serum calcium levels.

Potassium and calcium are intracellular cations performing their main functions in tissues, and hence, their serum concentrations do not reflect their actual distribution in the body.

Normal serum chlorine concentration in patients of the elder age groups can be explained by the fact that this element is the main extracellular anion in the organism responsible for the maintenance of acid-base balance and osmotic pressure, which virtually do not fluctuate.

Reduced magnesium level in the serum can be explained by high consumption of this element by tissues because of chronic stress, by reduced in-

TABLE 1. Serum Concentrations of Macro- and Trace Elements in Patients of Different Age Groups ($M \pm m$)

Element	Serum concentration of elements, μg/ml			
	normal level (mean age 46.6 years)	age group, years		
		60-74 (n=47)	75-89 (n=43)	90-102 (n=29)
Iron	2.5±0.4	1.87±0.30	1.67±0.30	1.49±0.40
Zinc	0.5±0.2	1.61±0.20	1.93±0.30	2.34±0.40
Copper	1.2±0.4	2.02±0.30**	1.56±0.40**	0.63±0.10**
Potassium	227±13	142.9±6.0	127.3±6.0	153.3±7.0
Calcium	124±4	48.5±2.0*	39.6±1.4*	44.5±3.0*
Chlorine	3630±20	3821.5±176.0	3700.4±140.0	3464.0±174.0
Magnesium	21.4±1.5	19.6±2.0*	18.7±2.0*	13.5±2.0*
Sulfur	523±24	890.9±39.0**	792.9±46.0**	675±29**

Note. *p<0.01, **p<0.005 compared to normal.

tensity of synthetic processes in which chlorine is involved, and impaired absorption in the gastrointestinal tract in patients of the elder age groups [10].

Elevated serum concentration of sulfur is presumably explained by the fact that sulfur is a component of protein structures whose degradation increases with aging, which is seen from high serum concentration of this element [12].

Hence, serum concentrations of macro- and trace elements in patients of elder age groups differ significantly from normal levels and depend on the age and presence of diseases.

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