ACUTE EXOGENIC INTOXICATIONS AND LEVEL OF THE ANTIOXIDANT SELENIUM

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Summary. The human organism possesses a well built antioxidant defence system having as a purpose neutralizing the free radical processes. The antioxidant defence of the human organism can be divided in to three functional levels. Great importance is given to the second level represented by enzyme and non-enzyme components which defuse the already formed free radicals. Here a main representative is the microelement selenium. Aim of the study was tracing the level of selenium – a main element of the secondary antioxidant defence system of the human body in acute exogenic intoxications with cerebrotoxic medicaments, alcohol and heroin. The study is prospective and longitudinal comprising 118 patients with average and heavy degree of acute poisoning with cerebrotoxic medicaments (n=45), alcohol (n=40), heroin (n=33) and control (n=35). The clinical laboratory tests are made under definite standards of the clinical laboratory. Following statistical analyses are used: variational analysis/u-criterion for normal distribution, t-test of Student, dispersive analysis under the method of ANOVA test and non-parametric analysis. Our results show a statistically significant decrease of serum concentration of selenium in acute exogenic intoxications with cerebrotoxic medicaments, alcohol heroin – $P<0,001$, without it correlating with the weight of the acute intoxication – $P>0,05$. As a reliable marker for a complex estimate of the antioxidant system of humans is the tracing the serum level of selenium and its careful interpretation.

Key words: *selenium, enzyme and non-enzyme antioxidants, acute intoxications*

INTRODUCTION

Selenium (Se) is an essential microelement having various functions – immune, anticancerogenic, antimutagenic and it plays an important role in slowing down the ageing processes, prevents from cardiovascular diseases etc. [1, 3, 8, 12, 19]. The interest towards selenium increased immensely with the proof discovery that it participates in the antioxidant defence of the organism. This element is a powerful antioxidant, with power 50-100 times more than that of vitamin E [6]. The antioxidant properties of selenium are mainly due to GPx, part of which contents is the Se itself [14]. For the time being, the protective action of Se against oxidative stress is unclear, especially against the oxidative DNA damage [20]. By proving its antioxidant properties during the last years it is included in the group of the maim antioxidants building the antioxidant defence system of the human organism [4, 15]. Together with vitamins C, E and β-carotene it is officially recognized as an antioxidant micronutrient by FDA (Food and Drug Administration – USA) [5].

During the last years, the clinical and most of all the experimental toxicology gained a lot but contradictory data regarding the relation between selenium as antioxidant and the various acute intoxications. As a whole, the selenium status in patients with acute intoxications is not very well studied. According to some authors, in various intoxications, there is deficiency of this microelement [13], while according to others in people with acute intoxications the selenium deficiency is not present.

It is considered that the serum concentration of selenium, having priority over the concentration in the whole blood, 24 h urine and level of Se-GPx, serves for a better judgment of selenium status [1, 16, 18].

PURPOSE

Tracing the serum level of selenium – main element of the secondary antioxidant defence system of the human body in acute exogenic intoxications with cerebrotoxic medicaments, alcohol and heroin.

MATERIAL AND METHODS

A prospective and longitudinal study was done comprising 118 patients with average and heavy degree of acute exogenic intoxication with cerebrotoxic medicaments (n=45), alcohol (n=40), heroin (n=33), 38 of them women and 80 of them men aged from 17 to 72, treated in the Intensive sector of toxicology at the Clinic for professional diseases and toxicology – multiprofile hospital for active treatment, University Hospital “Sv. Georgi” in the town of Plovdiv, within the period 2002-2004. The control group comprised selected 35 healthy men and women, juxtaposed in age and sex with the traced patients. All the clinical tests were done

in the central clinical laboratory of University Hospital "Sv. Georgi" in Plovdiv. The laboratory participates in national and international systems for external estimation of quality and possesses the corresponding certificates.

Selenium

Reactives: Selenium standard solution 1000 mg/l Se (MERCK)

Analyzer: Atomic absorption spectrophotometer Zeeman 5100 PC, Perkin-Elmer, U.S.A.

Principles: the tested probe, the chemical compounds of selenium respectively in the content atomize under the infl graphite furnace (2100ºC). Through the so obtained cloud of free atoms of selenium passes a sunray with λ=196 nm, coming from a non-electrode lamp. The atoms absorb the light as a result of which the intensity of the sun ray decreases, proportionally to the number of the absorbing atoms.

Analytical reliability:

Nonreproductivity in series – CV < 5.7%;

Nonreproductivity in time – CV < 7.2%; recovery: 102%.

Reference interval: 46 – 190 μg/l

In the statistical processing of the gathered primary information, there are used: variational analysis/u-criterion for normal distribution, t-test of Student, dispersive analysis under the method of ANOVA test and non-parametric analysis (in case of symptoms with distribution different from the Gauss-Laplace distribution is used the Pearson criterion, Kolmogorov-Smirnov criterion, Kendall coefficient, and Kruskall-Wallis criterion).

RESULTS AND DISCUSSIONS

Our results show a very high value of F-criterion in selenium examining as a main indicator with antioxidant features (Table 1).

There can be seen vividly expressed statistical differences in the three studied groups with acute intoxications defined by the higher value of selenium in the control group i.e the deficiency established there significantly differentiates patients with acute intoxications from the control groups of healthy people.

Table 1. Average values of serum selenium (μmol/l) in the tested groups

Indicators / Groups	Number	X± Sx	Sx	F	P
Heroin	33	93,79 ± 3,00	17,24		
Alcohol	40	80,85 ± 3,48	21,99	33,09	< 0,001
Medicaments	45	99,72 ± 3,41	22,90		

Control group	35	124,43 ± 1,76	10,39		

The inside group comparison with the u-criterion for normal distribution shows significant differences between alcohol and heroin on the one hand (u=3,33, P<0,001), and alcohol and medicaments on the other (u=4,49, P<0,001).

A lot of authors state that there is such deficiency of the antioxidant in various acute intoxications [2, 13, 17, 21, 22].

The explanation of these results is of utter interest. One of the possibilities is for the selenium deficiency to have a leading role in the pathogenesis of acute exogenic intoxications. If we accept this leading position of selenium deficiency, we should expect after a reactive intake of the antioxidant in optimal dosage during the acute intoxication a faster recovery of the patient from the acute condition and "blocking" the emergence of various complications in direct connection with the acute intoxication. Similar tests in the sphere of the experimental toxicology are still inceptive, incomplete/fragmentary and cannot give scientifically proven conclusions.

More probable appears to be the second possibility – the lower values of selenium in acute intoxications to be an effect of the very intoxication. There is also lack of enough studies and categorical standpoints. We should expect that the serum selenium decrease will go in parallel with the heavier extent of the intoxication, since it is accepted that the heavier intoxication is connected with stronger formation of reactive oxygen type in the organism. The antioxidant enzyme defence having as a main component SE-GPx starts to fight against the growing oxidative stress. It is possible the oxidants (the toxic matter respectively) to block the synthesis of antioxidant enzymes. Thus the hypothesis can be stated that under this complex mechanism there appears selenium deficiency in the human organism of the intoxicated patient and this deficiency is expected to become more evident with the heavier extent of intoxication.

However, our results show that there is no significantly expressed distinction between the serum level of selenium and the level of heaviness of the acute intoxications.

Table 2. Selenium (μmol/l) – type of the toxic material and the level of severity of the acute intoxication

Group	Level of heaviness	Number	X ± Sx	Sx	t	P
Heroin	Average heavy	13	98,08 ± 5,37	19,37	1,11	> 0,05
	Heavy	20	91,00 ± 3,49	15,59		
	Total	33	93,79 ± 3,00	17,24		
Alcohol	Average heavy	25	81,88 ± 4,08	20,39	0,36	> 0,05
	Heavy	15	79,13 ± 6,48	25,10		
	Total	40	80,85 ± 3,48	21,99		

Medicaments	Average heavy	30	100,79 ± 4,33	23,72	0,45	> 0,05
	Heavy	15	97,60 ± 5,63	21,80		
	Total	45	99,72 ± 3,41	22,90		
Total	Average heavy	68	93,32 ± 2,81	23,19	0,94	> 0,05
	Heavy	50	89,42 ± 3,05	21,54		
	Total	118	91,67 ± 2,07	22,49		

These results are in contradiction with the stated by E. A. Luzhnikov [10] opinion that in light and average heavy acute intoxications with psychotropic medicament the most significant changes are seen in the components of the antioxidant system while in the heavy extent of intoxicati

oxidation.

It should be underlined, however, that there is lack of studies on the connection between the selenium level and the extent of the acute intoxications with medicaments, alcohol and drugs in the experimental and clinical toxicology.

The significant decrease of selenium in acute intoxications with heroin, alcohol and cerebrodepressive medicaments, without it having any connection with the heaviness of the intoxication, may be related with the reduced intake of selenium (through foodstuffs and water) in the organism and its distribution in the environment. We have in mind the studies of K. Tsachev [16]; according to him, Bulgaria is located in a geological area deficient in selenium. The multitude of studies on the selenium distribution and its real intake in the organism show that the larger part of the population of the developed countries is in condition of boundary deficiency of a number if microelements, including selenium [6, 9]. When all this transfers on an acute intoxication, then additional specific pathophysiologic factors, helping for extending such deficiency start to influence. That is why we think that our cases are with pre-morbid reduced levels of selenium and the clinical and clinical-laboratory studies that we present in the this work could introduce additional clearness regarding the role of the antioxidants, and the microelement selenium in acute exogenic intoxications in particular.

Having in mind the doubtless fact that the antioxidant properties of selenium are mainly due to GPx, part of which selenium is – it could be sought the dependence between the serum selenium and Se-GPx or their concentration in the various tissue and structures in close connection with the corresponding pathologic process (the acute intoxication in particular). According to some authors, there exist proportional dependency between the indicators of the enzyme and the serum level of the microelement [7]. Others claim there is no such dependency [11]. Similar tests could allow to be tested the thesis for “displacement” of the microelement (serum selenium), towards the places of synthesis and action of the antioxidant enzymes with following-up step by step decrease of the serum concentrations.

As a conclusion we can say that selenium, having a leading role in the antioxidant defence of the organism shows statistically significant decrease of the serum concentration in acute intoxications with cerebrodepressive medicaments, alcohol and heroin, without it being in correlation with the level of heaviness of the acute intoxication.

In science literature, there are stated contradictory standpoints regarding the use of single antioxidants or a packet of such antioxidants as a reliable marker for estimate of the antioxidant barrier in humans. It is logical to be accepted that the deepest idea comes from the simultaneous study of all antioxidant indicators, which is labour-intensive, expensive and practically inapplicable. The significant decrease of selenium gives grounds to suggest its study as an obligatory antioxidant indicator in acute intoxications, no matter whether it is with preliminary decreased values or it decreases in the course of intoxication. We believe that the study of selenium as a main antioxidant and its careful interpretation would allow a complex estimate of the antioxidant system, including diagnostics and prognostics of the acute exogenic intoxications.

The summarized results give us serious grounds to recommend supplement of selenium-containing preparations in patients with acute exogenic intoxications, especially such in heavy extent.

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