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Zinc Levels in Healthy Human Serum and Urine. Effects After Intravenous Administration of Zinc Sulphate

Zinc is a trace element widely found in nature. Since 1940, when the first zinc-metaloenzyme, carbon anhydrase, was discovered, its important physiological role in human beings has become more and more evident and today over one hundred zinc-bearing metaloenzymes are known (7, 9). Zinc plays a part in such vital processes as the synthesis of nucleic acids and proteins and the metabolism of carbohydrates and lipids (1, 2, 5, 6). The aim of this work has been to investigate the behaviour of zinc in the blood and urine of healthy, adult subjects after receiving an intravenous injection of zinc sulphate while in a state of fast.

Blood and urine samples were taken from a group of healthy volunteers, 21 male and 18 female, from 19 to 52 years of age (average age 23). The protocol was given prior approval by the Committee for Research and Clinical Trials. Volunteers were selected according to the following criteria: They were suffering from no chronic illness, had had no acute infection during the three weeks prior to the tests, and were not regular takers of alcohol or any other drugs. Their haematological parameters (red corpuscles, haemoglobin and haematocyte) were all normal. The results were negative for hepatitis B, syphilis and AIDS. Urine samples were taken 24 hours before the study begun. After 12 hour fasting, 5 ml of venous blood was taken. Subsequently 8 mg of zinc in the form of $ZnSO_4$ were injected i.v. Blood samples were drawn from an antecubital vein after 0.5, 1, 2, 4 and 24 h. Urine was collected for 24 hours after the zinc injection. All the samples and subsequent tests were carried out using disposable plastic equipment. The blood serum was allowed to coagulate in a plastic tube for 30 min at room temperature, then centrifuged at 3,000 r for 5 min and stored at 40° C until analysed. Any samples showing even minimal signs of haemolysis were discarded. Each volunteer collected his urine for 24 hours after the zinc injection, which was measured, being the individual samples kept separated. Each blood and urine sample (0.5 ml) was dissolved in 2 ml of deionized water. The samples were mixed sith a mechanical shaker and subsequently the zinc concentration analyses were carried out in duplicate with an atomic absorption spectrophotometer (Perkin-elmer, USA, model 560), with slit 0.7, wavelength 213.9 and an oxyacetylene flame.

Student's t test was used to compare the differences in zinc concentrations in blood and urine between sexes. The differences in blood zinc levels at the various times sampled were tested by a variance analysis and Dunnet's test was applied to each variance versus the basal level.

The average zinc concentration in plasma increased during the first four hours after injection and then gradually decreased, returning to basal levels at twenty-four hours. The highest level was registered after half an hour (table I). No statistically significant differences were oserved between males and females. The average urinary zinc excretion levels are

Table I. *Mean zinc levels in blood (μg/100 ml) in 39 healthy adults after intravenous administration of zinc sulphate.*

Time (h)	Zn levels (μg/100 ml)	p
0	119±19	
0.5	199±32	< 0.001
1	183±32	< 0.001
2	156±32	< 0.001
4	130±28	< 0.05
24	110±19	N.S.

shown in table II. Metabolic alterations may not be revealed in isolated blood or urine checks and this is particularly true of possible zinc deficiency. Thus, the aim of this study has been to recognise the existence of zinc deficiency in normal people by administering a parental overload of this trace element. This type of research has not been reported so far, although PECOUD *et al.* gave zinc orally to humans (8) and TANABE administered it through the peritoneum (10) in studies on animals. The timing of the blood samples, at 0.5, 1, 2, 4 and 24 hours was based on several assays, which showed that this schedule supplied best information concerning zinc kinetics while being in general the most convenient one for the volunteers.

An increase in the amount of zinc excreted in the urine of healthy subjects would lead to the conclusion that the body was suffering no deficiency in this metal; otherwise it would store some of the overload. Just such an increase in urine zinc levels occurred as a result of the experiment and, although some quantity of the excess may have been eliminated through the biliary, pancreatic and salivary tracts or by sweating or accumulation in the liver (3, 4, 10), our results show fairly conclusively that there was no zinc deficiency in our volunteer subjects. The zincemia curve together with that for urine excretion rates in healthy subjects help to establish a normal profile for zinc kinetics and these parameters may be used as a reference when detecting anomalous situations in human zinc levels. One last important point is that none of the volunteers suffered any obvious adverse effects from the zinc overload.

Table II. *Urine zinc levels (μg/100 ml) in healthy adults (n = 39).*

	Basal	Post-injection
Males	719±324	941±373[b]
Females	486±170[a]	585±211[b]

[a] p < 0.01 vs males; [b] p < 0.01 vs basal levels.

Key words: Zinc, Blood, Urine, Healthy adults.

Palabras clave: Zinc, Sangre, Orina, Adultos sanos.

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B. GIL-EXTREMERA*, A. MALDONADO, M. RUIZ-MARTÍNEZ and M. A. RUBIO

Departamento de Medicina
Hospital Universitario de Granada
18012 Granada (Spain)

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* To whom all correspondence should be addressed.