Perspective

Selenium supplementation in the prevention of coronavirus infections* (*In Memory of Laszlo G. Egyud)

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Abstract

Selenium (Se) is a ubiquitous element akin to sulfur (S) existing in the Earth’s crust in various organic and inorganic forms. Selenium concentration varies greatly depending on the geographic area. Consequently, the content of selenium in food products is also variable. It is known that low Se is associated with an increased incidence of cancer and heart diseases. Therefore, it is advisable to supplement your diet with this element albeit in a proper form. Although blood increased concentrations of Se can be achieved with various pharmacological preparations only one chemical form (sodium selenite) can offer true protection. Sodium selenite, but not selenate, can oxidize thiol groups in the virus protein disulfide isomerase rendering it unable to penetrate the healthy cell membrane. In this way, selenite inhibits the entrance of viruses into the healthy cells and abolishes their infectivity. Therefore, this simple chemical compound can potentially be used in the recent battle against the coronavirus epidemic.
relatively high doses of selenium (up to 2,000μg/day) were reported to be well tolerated in patients with peritonitis [10]. The LD₅₀ dose for sodium selenite in rats was established to be 4,100μg/kg bodyweight, which is a hundred-fold greater than that generally accepted for humans. In humans, mild symptoms of toxicity in the form of reversible hair loss and fingernail brittleness start to occur at a dose of 1,000 μg/day during one year of observation. Organic Se compounds are less toxic than inorganic, but the LD₅₀ doses vary greatly depending on the duration of exposure, the experimental model, and the blood concentrations achieved. More recently Nuttal [8] indicated that selenium concentration in human serum ranges from 400 to 30,000μg/L, the levels >1,400μg/L being non-toxic. The LD₅₀ dose for sodium selenite in rats was established to be 4,100μg/kg body weight, which is a hundred-fold greater than that accepted for humans. It is generally believed, albeit not confirmed, that the toxic doses of selenite start from 600μg/day. However, symptoms of toxicity in the form of reversible hair loss and fingernails brittleness start to occur at a dose of 1000μg/day in a year. Because of such conflicting data on selenium toxicity, the author of this article had decided to ingest 10,000μg of sodium selenite in one dose. Subsequent tests revealed that neither bleeding time nor the clotting time was lengthened in these experiments. Therefore, theLD₅₀ for human beings was calculated to be 4,100μg/kg body weight. It is important to note that this chemical reagent is rather inexpensive and readily available online. It is only unfortunately that physicians, having limited knowledge of this mineral, cannot understand that such a simple chemical substance can have such dramatic health effects.

It is generally believed that selenium and its compounds are antioxidants. This confusing notion stems from the observation that selenium is a cofactor in glutathione peroxidase, a biologically powerful antioxidant. It should be noted that the term ‘oxidation’ is somewhat misleading because it does not always involve oxygen atoms. Simply, an oxidant is an atom and/or a molecule that accepts, and a reductant is such that always involve oxygen atoms. The process of oxidation is a form of electron transfer. Organoselenium compounds react with thiol groups (-SH), which are then oxidized by selenium to inactive disulfide (S-S) groups. This oxidizing capacity of selenium has very important implications for its antiviral property. Selenium reacts readily with the sulfhydryl (-SH) groups in the active site of viral Protein Disulfide Isomerase (PDI) converting them to inactive disulfide according to the following formula:

\[ \text{PDI-(SH)}_2 + \text{Se}^{4-} \rightarrow \text{PDI-SS-PDI} + \text{Se}^{6+} \]

In this way, the viral hydrophobic spike loses its ability to undergo the exchange reaction with disulfide groups of cell membrane proteins and thus prevents virus entrance to the cell cytoplasm [11]. The same mechanism applies to the action of surface disinfection agents that contain oxidizing agents such as phenol, hydrogen peroxide, and hypochlorite [12]. It should be noted that selenium has been implicated as an important factor in aging and aging-related diseases [13], and the prevention of mammary cancer [14]. There are also numerous reports describing the relationship between selenium and other diseases such as type 2 diabetes mellitus [15], asthma [16] and cardiovascular diseases [17]. The significance of selenium in human health was extensively reviewed by Brown & Arthur [18]. Apparently, these diseases are associated with the increased expression of the protein thiol groups (-SH), which are then oxidized by selenium to inactive disulfides (S-S).

Given the facts mentioned above, it seems logical to assume that selenium selenite could represent an ideal agent for the prevention of viral infections including coronavirus, according to the mechanism suggested for the Ebola virus [19]. It should be mentioned that this chemical reagent is rather inexpensive and readily available online. It is only unfortunately that physicians, having limited knowledge of this mineral, cannot understand that such a simple chemical substance can have such dramatic health effects.

References


