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A Proposed Weapon in the Anti-COVID-19 Arsenal: Percutaneous Zinc Absorption

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Abstract

Coronaviruses are large, enveloped, single-stranded, positive-sense RNA viruses with a genome of approximately 30 kilobases in length. The genus Coronavirus belongs to the family *Coronaviridae* in the order *Nidovirales*. They are classified into three groups. Group 1 contains various mammalian viruses including porcine epidemic diarrhea virus, porcine transmissible gastroenteritis virus, and human coronaviruses 229E and NL63. Group 2 includes canine respiratory coronavirus among other mammalian viruses and human coronavirus OC43. Human severe acute respiratory syndrome coronavirus (SARS-CoV) is considered a distant relative of this group. Group 3 contains solely avian coronaviruses. Human coronaviruses (HCoVs) cause respiratory infections, mainly, but gastroenteritis and neurological disorders may also occur. So far, at least six human coronaviruses have been described including SARS-CoV2, which was just identified in 2020, and two of these coronaviruses (OC43 and 229E) are responsible for 10-30% of all common colds. HCoV-HKU1 is mostly associated with bronchiolitis and pneumonia.

Keywords: Corona virus • Zinc • Acute respiratory syndrome • Anti-COVID

Introduction

RNA synthesis occurs in the life cycle of the SARS-CoV virus in order to reproduce its genetic material and is catalyzed by an RNA-dependent RNA polymerase, which is the core enzyme of a multiprotein replication/transcription complex. In the case of SARS-CoV, an excess of intracellular zinc ions has been found to efficiently inhibit the RNA-synthesizing activity of this replication and transcription multiprotein. Enzymatic studies *in vitro* have revealed that zinc directly blocks the activity of the RNA polymerase by inhibiting elongation and reducing template binding. This RNA polymerase, which is a central component of the corona viral replication/transcription machinery, is well conserved among the members of the coronavirus family including SARS-CoV2 [1-4]. Therefore, it is quite possible that zinc treatment would have a similar effect on SARS-CoV2 and interfere with its ability to replicate at the biochemical level.

Since current research indicates that the mineral, zinc, can inhibit the replication of coronavirus and a variety of other RNA viruses in cell culture, it has become a potentially important and interesting supplement to study at this time. In the human body, zinc performs a variety of vital antioxidant functions and is required for maintaining good health. Inside the cell, the harmful effects of free radicals are balanced by the action of antioxidant enzymes (such as copper-zinc superoxide dismutase) and non-enzymatic antioxidants (such as metallothioneins). As zinc cannot pass easily through membranes, zinc-transporting proteins, ZIPs (Zrt-Irt-like protein or Zinc Iron permease) and ZnTs (Zinc transporters) help to facilitate this process. Metallothionein also aids in the regulation of zinc levels and the distribution of this metal in the extracellular space. The presence of zinc within the cell causes an increase in metallothionein, which is the major zinc-binding protein, and together they form a thermodynamically stable complex [5,6]. Thus, low risk ways of increasing zinc bioavailability in the body can be safely considered.

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In rats, rice fortified with zinc oxide or zinc carbonate is a feasible vehicle for zinc absorption, although zinc oxide displays lower bioavailability than zinc carbonate [7]. In young adults, zinc absorption from supplemental zinc citrate is comparable with that from zinc gluconate, but higher than from zinc oxide [8]. It is already known that zinc can be absorbed from topical (non-nano) zinc oxide by human skin in small quantities (nano forms of zinc oxide are not associated with significant zinc absorption) [9]. One of our recent studies suggests that zinc is absorbed by the human body from our sun-care products (all with the same basic formula containing a medicinal form of zinc oxide) in sufficiently large quantities with regular use [10]. So, recently, when our company received an inquiry from Health Canada regarding any innovations that may benefit Canadian health workers at this critical time during the novel coronavirus pandemic, the answer was that we do have a product that may be useful to medical professionals and health workers in the field. It is a natural, award-winning sun-care product specially formulated to block apoptotic sunburn (Skin Protector Plus). Its active ingredient is a non-nano, medicinal form of zinc oxide. The novel thing about this product is that it appears to be an efficient delivery system for boosting zinc levels in the whole body in a relatively short period of time. There is no toxicity associated with this product due to the use of high grade zinc oxide and natural ingredients. Since it is so safe and contains no harsh chemicals (already tested on human volunteers), no pre-clinical trials would be required to test its efficacy in protecting subjects from COVID-19 in a clinical study. The objective of such a comprehensive study would be to test and confirm the hypothesis outlined above, *in vivo*; namely, if maximum zinc levels are maintained in the human body via percutaneous zinc absorption from a topically applied zinc oxide cream, then it may provide one suitable defense against SARS-CoV2 infection. Although oral supplementation is also an option, this type of topical application on the surface of the skin may be a faster method of ensuring even zinc distribution throughout the body and delivery to the various potential points of viral entry. Moreover, it may actually provide a physical barrier or blockade against entrance of the virus into the body by allowing suffusion and accumulation of zinc pools directly beneath the skin.

Discussion

The experimental design would involve a test group of ten or more uninfected health workers, who are regularly exposed to COVID-19, using the Skin Protector Plus cream daily. A matching uninfected control group would receive a placebo ointment without zinc oxide. The body zinc levels of both

groups would be monitored until they reached maximum levels in the test group and these levels would be maintained for three to four weeks or for the duration of the trial. At the end of the study, both groups would be tested for COVID-19 infection, once again, and the rate of infection in the two groups would be analyzed statistically and compared.

Conclusion

If the rate of COVID-19 infection were found to be lower in the test group than in the control group in this study, then these results would indicate that a degree of temporary immunity or protection from the new virus could be achieved by rapidly building up the body's zinc reserves with a topically applied zinc oxide cream. Similar simultaneous studies could prove to be a cost-effective way of finding a possible solution for combatting COVID-19 on the frontlines in the absence of an approved vaccine and as a future method of secondary defense against certain RNA viruses. Coating surgical masks with a thin layer of zinc may also be worth considering.

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