In Vivo Delivery and Removal of Metals

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Technology description

Current State of the Art:
Gold-based drugs are currently used in the treatment of rheumatoid arthritis, have demonstrated efficacy in clinical trials in malaria treatment, and most recently have significantly reduced the reservoir of viral DNA and the population of long-lived HIV-infected memory CD4+ cells in pre-clinical studies. In addition, chelation therapy is a mainstream treatment used to treat heavy metal poisoning. However, chelation therapy is also used as an alternative therapy (and not approved by the FDA) for treatment of heart disease, cancer, and other conditions. It most often involves the injection of ethylene diamine tetraacetic acid (EDTA), a chemical that binds, or chelates, heavy metals, including iron, lead, mercury, cadmium, and zinc.
Disadvantages with the Current Art:
Gold compounds, which have therapeutic properties, also have serious systemic side effects. These compounds do not currently provide local therapy to the target cells resulting in systemic toxicity and side effects. In addition, there are challenges in achieving a gradual release of the compounds that would provide a sustained, local dose.
Current solid-based chelation therapies (such as charcoal) are relatively nonspecific and not efficient for metal ions. Organic chelators (such as EDTA) are more difficult to sequester in a solid phase because they are water-soluble. In addition, current chelation therapies often have toxic liabilities or result in derivatives that are toxic.
Monosodium titanate (MST) is a ceramic that strongly binds specific metal ions and has been used to sequester metal ions of strontium, neptunium, and uranium from aqueous radioactive waste. Researchers from the Medical College of Georgia have demonstrated that MST is also effective at binding mercury, gold, and cadmium ions.

Application area

The research has demonstrated a potential application of MST as a scavenger of biometals such as cadmium or mercury, and as a drug delivery source for gold-based drugs.

Advantages

MST has exhibited high affinity for biometals and could provide a significant advantage in delivery of metal ions to target cells or removal of metal ions from cells in a more efficient manner. MST is more corrosion resistant when compared to current therapies and could be delivered as a solid phase for targeted therapy. In addition, tests for biological toxicity were favorable for further development of these unique materials. Possible applications for MST include the delivery of anti-arthritic compounds, such as Auranofin®, delivery of novel drugs for cancer therapy, delivery of drugs to the periodontal sulcus, treatment of acute metal toxicity, treatment of metabolic diseases in which metal accumulation occurs, and MST could even be used for sequestration of mercury from dental waste water.

Institution

Augusta University

Inventors

John Wataha
Associate Professor
Oral Biology
Regina Messer
Associate Professor
Oral Biology
Jill Lewis
Associate Professor
Oral Biology
David Hobbs

联系我们

叶先生

电 话：021-65679356

手 机：13414935137

邮 箱：yeyingsheng@zf-ym.com