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SHORT REVIEW

Removal of Heavy Metals from the Body System by Chelation Therapy

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ABSTRACT

Heavy metals are toxic to both human and plant, cause water and soil pollution. It is necessary to eliminate the toxic heavy metal ions from the body system before it is released into the environment. Chelating agents are able of binding to toxic heavy metal ions to form complex structures which are easily excreted from the body removing them from intracellular or extracellular spaces. There are several methods are applied for removal of heavy metal ions but Chelation therapy is the most advanced one. In this review, we present a revise of the existing chelating agents for the treatment of heavy metals and metalloid intoxications.

Introduction

Heavy metals are the class of metallic/metalloids elements that have a comparatively high density compared to water [1]. In recent years, there has been a most crucial issue for our biological and worldwide public health concern associated with environmental contamination by heavy metals. The reuse, separation, and purification of industrial waste are the challenges of our modern science. Various reported sources of heavy metals in the surroundings include industrial, geogenic, pharmaceutical, agricultural, and atmospheric sources [2]. Most of the heavy metals ions are carcinogens in nature and lead to serious health concerns for both animal and plants. Some important metals such as Fe, Mg, Co, Cu, Cr, Mo, Mn, Ni, and Zn are the essential nutrients for both plants and animals that are necessary for various biochemical and physiological functions mainly growth of life system. But, it creates an adverse effect on the biological system when it exceeds its optimum levels (ppm range), which results in a variety of deficiency diseases and damage the several organs like brain, liver, kidney, blood circulation and nerve transmission [3]. Metals with their toxicity range in drinking water according to W.H.O. were given in Table 1. There are some other metals, which have no traditional biological functions and are considered as non-essential metals such as Al, Sb, As, Cd, Au, Pb, Hg, Ni, Pt, Ag, Sn and V etc [4]. Therefore, removal of heavy metal ions from the body is of special concern for the environmental researcher and scientists [5].

Environmental Occurrence

Heavy metals are toxic and carcinogenic in nature. They have unique physicochemical properties that confer to its specific toxicological mechanisms of action. Most of the heavy metals are produced industrially and have been

used to manufacture products with agricultural applications. Insecticides, fungicides, herbicides, algicides, wood preservatives, sheep dips, and dye-stuffs are the main source of heavy metals.

Table 1: Limits and common sources of various heavy metal ions.

Metal	Max. Conc. in drinking water (ppm)(WHO limits)	Common sources
Arsenic (As)	0.01	Arsenic based preservatives, pesticides, fertilizers.
Chromium (Cr)	0.05	Leather industry, tanning, chrome plating industries.
Cadmium (Cd)	0.005	Paints, pigments, batteries, photographic.
Copper (Cu)	1.3	Fertilizers, tanning, photovoltaic cells.
Lead (Pb)	0.05	Agriculture, lead paints, jewelry, lead batteries.
Mercury (Hg)	0.001	Volcanic emissions, solid waste incineration.
Silver (Ag)	0.1	Refining of copper, gold, nickel, zinc, jewelry, and electroplating industries.
Zinc (Zn)	5	Soldering, cosmetics, and pigments.
Nickel (Ni)	5.08	Alloys, nickel galena, Leather industry.

Role of Chelation Therapy for Removal of Metal Ions

Chelation therapy is a particular therapy, which is used for removal heavy elements from the body by the formation of a chelate complex with suitable chelating ligands in such a way that complex must be water-soluble and stable, less affinity to essential metal, less side effect, easily removed from the body system. Chelating ligands complexes with the metal ions and allows removal of excess or toxic metal from the system rendering it immediately nontoxic and reducing the late effects. Chelating agents can influence metal toxicity by mobilizing the toxic metal mainly into the urine [6]. Chelating ligands play an important role in the removal of heavy metal ions such as cadmium, copper, cobalt, zinc, nickel and lead through the formation of the stable complex. The ideal chelator should have high solubility in water, low Toxicity, ability to penetrate cell membranes, rapid elimination of the toxic metal and to form non-toxic complexes. $EDTA^{4-}$ is a versatile hexadentate chelating ligand that binds with a number of metal ions. Thus, endogenous low molecular weight compounds mainly amino acid such as citrate, arginine, cysteine, glutamate, and glutathione, as well as proteins, are metal-binding agents [7]. The porphin structure of hemoglobin uses nitrogen groups as chelating ligands resulting in a high affinity for iron. EDTA, BAL (British anti-Lewisite), DMSA (2,3-Dimercaptosuccinic acid), DMPS (2,3-Dimercapto-1-propanesulfonic acid), DPA (2-Amino-3-methyl-3 sulfanylbutanoic acid), Trientine, D-Penicillamine, Deferoxamine, Deferiprone are the most advanced and clinically important chelating agents. BAL is the organic dithiol compound, was developed as an experimental remedy against the arsenic-based poison gas Lewisite. For some fewer side effects of BAL, due to the presence of a thiol group, in the 1960s it modified into DMSA. After 1960, Soviet Union researchers have introduced DMPS as a mercury-chelating agent in attempts to reduce the body burden of poisonous metals in extremely suggestive patients [8-10]. Chelation therapy is a very simple process; it can make you feel physically tired and mentally foggy. In this process, the patient was free from Risk of Heart Attack, Stroke, Pain, Swelling and any other syndromes.

Conclusion

Anthropogenic activities of naturally occurring heavy metals ions contribute appreciably to environmental contamination. These metals are universal toxicants known to induce adverse health effects in both animals and plants. In modern time, several important developments have occurred in

the clinical treatment of acute and chronic metal poisoning. Among them, Chelation therapy is the most advanced one. Recognizing toxicant contributors to constant illness and conducting study to evaluate Chelation strategies and protocols to assess and address toxic metal bioaccumulation present possible for low-cost, secure therapies addressing significant origin causes of today's most costly, prevalent persistent diseases.

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