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Health Implications of Heavy Metal Overload

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Adverse health implications may result from accumulation of Heavy metals' (HM) overload in human body. The most commonly encountered toxic metals are Arsenic, Lead, Aluminum, Mercury, Cadmium, and Iron. They may enter the body through inhalation, ingestion, or dermal absorption. Exposure to environmental contamination with HM is a growing problem throughout the world that has risen dramatically in the last 50 years as a result of an exponential increase in the use of HM in industrial processes and products.

Recently, exposure to HM particles, even at levels below those known to be nontoxic, can have serious health effects. Virtually, all aspects of animal and human immune system functions are compromised by HM particulates exposure. The highly reactive nature of most metals results in forming complexes with other compounds such oxygen, sulfide and chloride by which they exert their toxicity [1].

With ongoing exposure and internal imbalance, the body starts retaining any metals and using them as a substitute for essential elements. For example, lead can substitute calcium, cadmium very readily substitutes zinc, and aluminum may substitute almost all trace elements. Stored HM are locked into the tissues, serving as place holders for the proper nutrients. Heavy metals disrupt a vast array of metabolic processes, alter pro-oxidant/antioxidant balance, and bind to free sulfhydryl groups, resulting in inhibition of glutathione metabolism, numerous enzymes and hormone function [2]. Nutritionally, HM are directly antagonistic to essential trace elements and compete with nutrient elements for binding sites on transport and storage proteins, metallo-enzymes, and receptors. Disruption of the metabolism and balance of nutrient elements results in marked aberrations in the metabolism of carbohydrate, protein/amino acids, lipids, neurotransmitters, hormones, and increase susceptibility to infections [3].

This can result in damaged or reduced mental and central nervous system' function by directly influencing neurotransmitter production and utilization. It can lower energy levels through altering numerous metabolic body processes and damage blood composition, liver, kidney, lung, and other vital organs [4]. Concentration of toxic heavy metals can disturb important biochemical processes enhancing oxidative damage which is the key component of chronic inflammatory diseases and initiator of cancer. Mudga et al. in 2010 concluded that based on experimental studies that improved the knowledge of human toxicology, heavy metal exposure results in developmental, several types of cancer, kidney damage, endocrine disruption, immunological and neurological disorders [5].

Long-term exposure may result in slowly progressive physical, muscular, and neurological degenerative processes. Heavy metal overload in the adrenal glands reduces the production of hormones, which cause early aging, stress, decreased sex drive and aggravation of menopausal symptoms. It can also lead to unresponsiveness of diabetics to their medications. In addition, it can lead to neurological diseases such as depression and loss of thinking power. Also aggravate conditions such as osteoporosis and hypothyroidism [6]. For obvious reasons, removing metals from the body safely has been a concern of occupational medicine specialists for many years and recently environmental medicine physicians.

In addition, toxic metals can increase allergic reactions, cause genetic mutation, compete with trace metals for biochemical bond sites, and act as antibiotics, killing beneficial bacteria. Much of the damage produced by toxic metals stems from the proliferation of oxidative free radicals they cause. Heavy metals can also increase the acidity of the blood. The body draws calcium from the bones to help restore the proper blood pH. Furthermore, toxic metals set up conditions that lead to inflammation in arteries and tissues, causing more calcium to be drawn to the area as a buffer. That contributes to hardening of the artery walls with progressive blockage of the arteries and osteoporosis. The overall vascular effects include oxidative stress, inflammation, thrombosis, vascular smooth muscle dysfunction, endothelial dysfunction, dyslipidemia, immune dysfunction, and mitochondrial dysfunction. The clinical consequences include hypertension, coronary heart disease; myocardial infarction, atherosclerosis, and renal dysfunction with proteinuria [7]. These metallic elements are also classified as human carcinogens (known or probable) according to the US Environmental Protection Agency and the International Agency for Research on Cancer [8].

Even minute levels of toxic elements have negative health consequences, affecting nutritional status, metabolic rate, and the integrity of detoxification pathways. For adults, silent symptoms of chronic, low level heavy metal accumulation in tissues can progress from a steady decline in energy, productivity and quality of life to accelerated cardiovascular disease, premature dementia and total debilitation. Chronic symptoms frequently associated with excessive accumulation of HM include fatigue, musculoskeletal pain, neurological disorders, depression, failing memory, and allergic hypersensitivity.

Diagnosing HM overload can be reached through complete medical history, including occupation, hobbies, recreational activities, and environment. An occasional history of ingestion often facilitates the diagnosis, particularly in children. Physical examination findings will vary according age, sex and health status of the individual, dose or form of the metal present, and time lapse since exposure.

Testing for toxic metals in biological fluids such as blood, urine or hair will give a clue for the diagnosis of arsenic, cadmium, lead, and mercury overload. Provocative Challenge tests using 6- or 24-hour urine collection after receiving oral chelating agents may be used to mobilize toxic elements in the body and determining urinary toxic element levels in the collected urine. In addition, hair analysis can be used as a general screening test for the presence of HM. Kidney function should be assessed before starting chelation therapy.

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Heavy metal toxicity is one of the most difficult conditions to treat in modern medicine. Treatment regimens for HM toxicity can vary significantly and should be tailored specifically to an individual's age, exposure, and medical condition. A protocol involving diet, nutritional balance and gentle detoxification has helped many to recover both physical and mental health.

Conventional and alternative medical treatments include chelation therapy, supportive care, and decontamination. Follow-up laboratory testing is required until metal levels are within the normal reference range, particularly when the exposure was acute or the person continues to have symptoms after treatment.

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