



Heavy Metals and the Human Nervous System: A Silent Threat

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DESCRIPTION

The human nervous system, a marvel of evolution, controls every aspect of our existence, from basic reflexes to complex cognitive functions. However, this intricate system is not impervious to external threats, and heavy metals represent one of the most insidious dangers it faces. Heavy metals, such as lead, mercury, cadmium, and arsenic, are ubiquitous in the environment due to various industrial processes, mining activities, and even natural sources. Lead is notorious for its harmful effects on the nervous system, particularly in children. Even low levels of lead exposure can lead to cognitive impairments, developmental delays, and behavioural problems. It interferes with neurotransmitter function, disrupts synaptic plasticity, and impairs the development of the myelin sheath, which insulates nerve fibres. This interference can result in lower IQ scores, attention deficits, and an increased risk of delinquency. In adults, chronic lead exposure can cause memory problems, mood disorders, and even peripheral neuropathy. Importantly, the nervous system is particularly vulnerable to lead during its development, making it crucial to prevent childhood exposure. Mercury exposure, especially to its highly toxic organic form, methylmercury, primarily affects the central nervous system. Methylmercury readily crosses the blood-brain barrier and accumulates in the brain, where it disrupts neurotransmitter function and interferes with neuronal signalling. Arsenic poisoning may cause skin lesions, while other heavy metals can lead to rashes and dermatitis. Some heavy metals, like cadmium, can accumulate in the kidneys and liver, causing organ damage and dysfunction. These tests can detect the presence of heavy metals in the body and assess the extent of exposure. Chest X-rays or other imaging studies may be used to assess lung damage in cases of metal inhalation. A thorough physical examination and medical history review are essential for identifying symptoms and potential sources of exposure. Chelating agents are administered to bind with heavy metals in the body, facilitating their excretion through urine. Common chelating agents include dimercaprol, EDTA, and succimer. Strict regulations and improved industrial practices can help reduce the release of heavy

metals into the environment. Prenatal exposure to mercury can lead to neurodevelopmental deficits in children, causing impairments in language, attention, and memory. In adults, chronic exposure to mercury can result in tremors, muscle weakness, and sensory disturbances, resembling the symptoms of Parkinson's disease. Cadmium is a potent neurotoxin that primarily affects the peripheral nervous system. It can lead to motor deficits, sensory disturbances, and even paralysis. Cadmium exposure has been linked to the development of peripheral neuropathy, a condition characterized by pain, tingling, and muscle weakness. Additionally, cadmium exposure has been associated with cognitive impairments, such as decreased attention and memory deficits. Although cadmium's effects on the central nervous system are less well-understood than those on the peripheral system, research suggests that it can disrupt calcium signalling in neurons, affecting their function. Arsenic exposure has been associated with various neurological symptoms, including headaches, confusion, and cognitive deficits. Chronic exposure to inorganic arsenic, which is more toxic than organic forms, can lead to neuropathy, with symptoms such as tingling, numbness, and muscle weakness. Heavy metals can induce oxidative stress in the nervous system, leading to the production of reactive oxygen species (ROS) that damage neurons and their supporting cells. Heavy metals can interfere with neurotransmitter release and receptor function, disrupting communication between neurons. Heavy metals can trigger an inflammatory response in the nervous system, further contributing to neuronal damage. Some heavy metals can compromise the integrity of the blood-brain barrier, allowing toxic substances to enter the brain more easily. Heavy metals can disrupt calcium signalling in neurons, affecting their excitability and function.

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CONFLICT OF INTEREST

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