Health Concerns

Health Concerns Quick Link

Heavy Metal Toxicity

Symptoms of Exposure and ToxiciTY

- Arsenic
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Exposure to toxic heavy metals is generally classified as acute, 14 days or less; intermediate, 15-354 days; and chronic, more than 365 days (ATSDR). Additionally, acute toxicity is usually from a sudden or unexpected exposure to a high level of the heavy metal (e.g., from careless handling, inadequate safety precautions, or an accidental spill or release of toxic material often in a laboratory, industrial, or transportation setting). Chronic toxicity results from

repeated or continuous exposure, leading to an accumulation of the toxic substance in the body. Chronic exposure may result from contaminated food, air, water, or dust; living near a hazardous waste site; spending time in areas with deteriorating lead paint; maternal transfer in the womb; or from participating in hobbies that use lead paint or solder. Chronic exposure may occur in either the home or workplace. Symptoms of chronic toxicity are often similar to many common conditions and may not be readily recognized. Routes of exposure include inhalation, skin or eye contact, and ingestion (ATSDR MMGs and ToxFAQs; Anon. 1993; WHO 1998; International Occupational Safety and Health Information Centre 1999; Roberts 1999; Dupler 2001; Ferner 2001).

Arsenic

Exposure to arsenic occurs mostly in the workplace, near hazardous waste sites, or in areas with high natural levels. Symptoms of acute arsenic poisoning are sore throat from breathing, red skin at contact point, or severe abdominal pain, vomiting, and diarrhea, often within 1 hour after ingestion. Other symptoms are anorexia, fever, mucosal irritation, and arrhythmia. Cardiovascular changes are often subtle in the early stages but can progress to cardiovascular collapse.

Chronic or lower levels of exposure can lead to progressive peripheral and central nervous changes, such as sensory changes, numbness and tingling, and muscle tenderness. A symptom typically described is a burning sensation ("needles and pins") in hands and feet. Neuropathy (inflammation and wasting of the nerves) is usually gradual and occurs over several years. There may also be excessive darkening of the skin (hyperpigmentation) in areas that are not exposed to sunlight, excessive formation of skin on the palms and soles (hyperkeratosis), or white bands of arsenic deposits across the bed of the fingernails (usually 4-6 weeks after exposure). Birth defects, liver injury, and malignancy are possible. (Arsenic has also been used in homicides and suicides.)

Lead

Acute exposure to lead is also more likely to occur in the workplace, particularly in manufacturing processes that include the use of lead (e.g., where batteries are manufactured or lead is recycled). Even printing ink, gasoline, and fertilizer contain lead. Symptoms include abdominal pain, convulsions, hypertension, renal dysfunction, loss of appetite, fatigue, and sleeplessness. Other symptoms are hallucinations, headache, numbness, arthritis, and vertigo.

Chronic exposure to lead may result in birth defects, mental retardation, autism, psychosis, allergies, dyslexia, hyperactivity, weight loss, shaky hands, muscular weakness, and paralysis (beginning in the forearms). Children are particularly sensitive to lead (absorbing as much as 50% of the ingested dose) and are prone to ingesting lead because they chew on painted surfaces and eat products not intended for human consumption (e.g., hobby paints, cosmetics, hair colorings with lead-based pigments, and even playground dirt). In addition to the symptoms found in acute lead exposure, symptoms of chronic lead exposure could be allergies, arthritis, autism, colic, hyperactivity, mood swings, nausea, numbness, lack of concentration, seizures, and weight loss.

Mercury

Acute mercury exposure may occur in the mining industry and in the manufacturing of fungicides, thermometers, and thermostats. Liquid mercury is particularly attractive to children because of its beautiful silver color and unique behavior when spilled. Children are more likely to incur acute exposure in the home from ingesting mercury from a broken thermometer or drinking medicine that contains mercury. Because mercury vapors concentrate at floor level, crawling children are subject to a significant hazard when the mercury is sprinkled throughout the house during religious ceremonies or when there is an accidental spill (Zayas et al. 1996). Mercury spills are difficult to clean up, and mercury may remain undetected in carpeting for some time. Symptoms of acute exposure are cough, sore throat, and shortness of breath; metallic taste in the mouth, abdominal pain, nausea, vomiting and diarrhea; headaches, weakness, visual disturbances, tachycardia, and hypertension.

Chronic exposure to mercury may result in permanent damage to the central nervous system (Ewan et al. 1996) and kidneys. Mercury can also cross the placenta from the mother's body to the fetus (levels in the fetus are often double those in the mother) and accumulate, resulting in mental retardation,

brain damage, cerebral palsy, blindness, seizures, and inability to speak.

Dental amalgam is also suspected as being a possible source of mercury toxicity from chronic exposure. Some physicians suggest that amalgam fillings could be part of the explanation for the explosion of learning problems and autism in children since World War II, a time period corresponding with the introduction and widespread use of mercury amalgam (O'Brien 2001). Studies in both animals and humans have confirmed the presence of mercury from amalgam fillings in tissue specimens, blood, amniotic fluid, or urine (Vimy et al. 1990; Willershausen-Zonnchen et al. 1992; Gebel et al. 1996; Omura et al. 1996; Sallsten et al. 1996; Isacsson et al. 1997). However, according to Dr. Robert M. Anderton of the American Dental Association, "There is no sound scientific evidence supporting a link between amalgam fillings and systemic diseases or chronic illness" (Anderton 2001).

The ADA does acknowledge that amalgam contains mercury and reacts with others substances. However, to date the ADA concludes that amalgam continues to be a safe material. Researchers reported finding "no significant association of Alzheimer's disease with the number, surface area, or history of having dental amalgam restoration" and "no statistical significant differences in brain mercury levels between subjects with Alzheimer's disease and control subjects" (Saxe et al. 1999).

Interestingly, the metallic mercury used by dentists to manufacture dental amalgam is shipped as a hazardous material to dental offices. Although the ADA does not advise removing existing amalgam fillings from teeth, it does support ongoing research to develop new materials that will prove to be as safe as dental amalgam (Anderton 2001). Symptoms in adults and children could include tremors, anxiety, forgetfulness, emotional instability, insomnia, fatigue, weakness, anorexia, cognitive and motor dysfunction, and kidney damage. People who consume more than two fish meals a week are showing very high serum levels of mercury.

Cadmium

Acute exposure to cadmium generally occurs in the workplace, particularly in the manufacturing processes of batteries and color pigments used in paint and plastics, as well as in electroplating and galvanizing processes. Symptoms of acute cadmium exposure are nausea, vomiting, abdominal pain, and breathing difficulty.

Chronic exposure to cadmium can result in chronic obstructive lung disease, renal disease, and fragile bones. Protect children by carefully storing products containing cadmium, especially nickel-cadmium batteries. Symptoms of chronic exposure could include alopecia, anemia, arthritis, learning disorders, migraines, growth impairment, emphysema, osteoporosis, loss of taste and smell, poor appetite, and cardiovascular disease.

Aluminum

Although aluminum is not a heavy metal, environmental exposure is frequent, leading to concerns about accumulative effects and a possible connection with Alzheimer's disease (Anon. 1993). Acute exposure is more likely in the workplace (e.g., unintentional breathing of aluminum-laden dust from manufacturing or metal finishing processes).

Chronic exposure may occur in the workplace from accumulated exposures to low levels of airborne aluminum dust and handling aluminum parts during assembly processes over many years. In the home, we are in constant contact with aluminum in foods and in water; from cookware and soft drink cans; from consuming items with high levels of aluminum (e.g., antacids, buffered aspirin, or treated drinking water; or even by using nasal sprays, toothpaste, and antiperspirants) (Anon. 1993; ATSDR ToxFAQs for Aluminum). Citric acid (e.g., in orange juice) may increase aluminum levels by its leaching activity.

Interestingly, aluminum-based coagulants are used in the purification of water. However, the beneficial effects of using aluminum in water treatment have been balanced against the potential health concerns. Water purification facilities follow a number of approaches to minimize the level in "finished" water (WHO 1998). Symptoms of aluminum toxicity include memory loss, learning difficulty, loss of coordination, disorientation, mental confusion, colic, heartburn, flatulence, and headaches.

Laboratory Testing and Diagnosis for the Presence of Heavy MetaLS

The diagnosis of heavy metal toxicity requires observation of presenting symptoms, obtaining a thorough history of potential exposure, and the results of laboratory tests. Laboratory tests routinely used for seriously exposed persons include blood tests, liver and renal function tests, urinalysis, fecal tests, x-rays, and hair and fingernail analysis. Many of these tests are not routinely performed in a doctor's office. However, your physician can take blood samples and send them to the appropriate testing laboratory. Chest x-rays are recommended for persons with respiratory symptoms, and abdominal x-rays can detect ingested metals (refer to the ATSDR ToxFAQs for specific information).

Arsenic

Arsenic levels can be measured in blood, urine, hair, and fingernails. Because arsenic clears fairly rapidly from the blood, blood tests are not always useful (Dupler 2001). Therefore, urine tests are the most reliable for arsenic exposure within the past few days; hair and fingernail testing are used to measure exposure over the past several months (ATSDR ToxFAQs for Arsenic). Abdominal x-rays can reveal metallic fragments (Ferner 2001). Note: Hair treatments, including hair dyes, can contaminate hair samples. When testing for any heavy metal, the most accurate results are obtained from hair that has not been chemically treated for at least 2 months.

Lead

When there are presenting symptoms of lead toxicity, blood testing is done. Blood lead levels in children higher than 10 mcg/dL are considered to be of concern (Ferner 2001; ATSDR ToxFAQs for Lead). Symptoms in adults may not appear until blood lead levels exceed 80 mcg/dL (Dupler 2001). However, medical treatment is usually necessary in children who have levels of 45 mcg/dL. Significantly lower levels of 30 mcg/dL in children can cause mental retardation or cognitive and behavioral problems (ATSDR ToxFAQs for Lead). A complete blood count (CBC) is also done to check for abnormalities on red blood cells (basophilic stippling). In children, long-bone x-rays may reveal bands called "lead lines" that indicate failure of the bone to rebuild. These bands are not actual lead concentrations, but are bone abnormalities. Adults do not have lead lines. X-rays of the abdomen can reveal swallowed objects, such as paint chips, fishing sinkers, curtain weights, or bullets (Ferner 2001). A less common test is measurement of lead in teeth (ATSDR ToxFAQs for Lead). All children with brain-related symptoms should be considered for lead toxicity (Ferner 2001).

Mercury

A 24-hour urine specimen is collected for measurement of mercury levels. Chest x-rays can reveal a collection of mercury from exposure to elemental mercury or a pulmonary embolism containing mercury (Ferner 2001). Abdominal x-rays can reveal swallowed mercury as it moves through the gastrointestinal tract. Blood and urine samples are used to determine recent exposure, as well as exposure to elemental mercury and inorganic forms of mercury. Scalp hair is used in testing for exposure to methylmercury. Liver and kidney function tests are also important in severely exposed persons. Blood mercury levels should not exceed 50 mcg/L (see the ATSDR Medical Management Guidelines).

Cadmium

Laboratory testing procedures for cadmium toxicity include collection of a 24-hour urine specimen, CBC, and hair and fingernail clippings. Blood levels show recent exposure; urine levels show both recent and earlier exposure (ATSDR). Blood levels of cadmium above 5 mcg/dL and creatinine levels in urine above 10 mcg/dL suggest cadmium toxicity (Dupler 2001). Note: The ATSDR is unsure of the reliability of tests for cadmium levels.

Aluminum

Testing procedures measure aluminum levels in blood, urine, hair and fingernails, and feces (ATSDR ToxFAQs for Aluminum). According to a spokesperson at the ATSDR in spring 2002, levels of aluminum that are recognized as average are less than 0.01 mg/L. However, blood testing might underestimate the total body level of aluminum; postmortem brain, lung, and bone measurements reveal much higher levels of aluminum than blood tests.

Significance of Individualized Treatment RegimeNS

It is very important to note that treatment regimens vary significantly and are tailored to each specific individual's medical condition and the circumstance of their exposure. Providing a complete history of the person, including their occupation, hobbies, recreational activities, and environment, is critical in diagnosing heavy metal toxicity. A possible history of ingestion often facilitates a diagnosis, particularly in children. Findings from physical examinations vary with the age of the person, health status of the person, amount or form of the substance, and time since exposure (absorption rate) (Ferner 2001).

Allopathic (conventional) and alternative medicine practitioners (and naturopathic practitioners to a lesser extent) treat heavy metal toxicity. Once toxicity is confirmed, all cases (even suspected) of heavy metal toxicity should be brought to the attention of a professional who is experienced in diagnosing and treating poisoning. Often professionals consult with regional poison control centers or medical toxicologists for added expertise. Emergency room personnel and first responders are trained in recognizing symptoms and in proper handling, decontamination, and treatment techniques in acute exposure cases (see the ATSDR Medical Management Guidelines).

Conventional and alternative medical treatment includes chelation therapy, supportive care (intravenous fluids, cardiac stabilization, exchange transfusion, dialysis), and decontamination (charcoal, cathartics, emesis, gastric lavage, surgery). These procedures typically require hospitalization or treatment in a health care or clinical setting (Dr. Joseph F. Smith Medical Library 2001). Follow-up is required with laboratory testing until reference levels are within and remain in the normal range, particularly when the exposure was acute or if the person continues to have symptoms after treatment (ATSDR Medical Management Guidelines; Wentz 2000). Additionally, if there is a suspected homicidal or suicidal association, proper medical and legal resources should be involved (Ferner 2001). Medical personnel should report exposures to the appropriate agency to prevent additional public health risks either in the workplace or in the home (ATSDR Medical Management Guidelines; Anon. 1993; WHO 1998; International Occupational Safety and Health Information Centre 1999; Roberts 1999; Dupler 2001; Ferner 2001; USNML/NIH 2001a; 2001b; 2001c; 2001d).

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