Cadmium poisoning

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Cadmium has no constructive purpose in the human body. Cadmium is extremely toxic even in low concentrations, and will bioaccumulate in organisms and ecosystems.

Cadmium poisoning

Classification and external resources

ICD -10	T56.3 (http://apps.who.int/classifications/apps/icd/icd10online/?gt51.htm+t563)
ICD -9	985.5 (http://www.icd9data.com/getICD9Code.ashx?icd9=985.5)

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Sources of exposure

In the 1950s and 1960s industrial exposure to cadmium was high, but as the toxic effects of cadmium became apparent, industrial limits on cadmium exposure have been reduced in most industrialized nations and many policy makers agree on the need to reduce exposure further. While working with cadmium it is important to do so under a fume hood to protect against dangerous fumes. Silver solder, for example, which contains cadmium, should be handled with care. Serious toxicity problems have resulted from long-term exposure to cadmium plating baths.

Buildup of cadmium levels in the water, air, and soil has been occurring particularly in industrial areas. Environmental exposure to cadmium has been particularly problematic in Japan where many people have consumed rice that was grown in cadmium contaminated irrigation water. This phenomenon is known under the name itai-itai disease.[1]

Food is another source of cadmium. Plants may only contain small or moderate amounts in non-industrial areas, but high levels may be found in the liver and kidneys of adult animals.

Cigarettes are also a significant source of cadmium exposure. Although there is generally less cadmium in tobacco than in food, the lungs absorb cadmium more efficiently than the stomach.[2]

Aside from tobacco smokers, people who live near hazardous waste sites or factories that release cadmium into the air have the potential for exposure to cadmium in air. However, numerous state and federal regulations in the United States control the amount of cadmium that can be released to the air from waste sites and incinerators so that properly regulated sites are not hazardous. The general

population and people living near hazardous waste sites may be exposed to cadmium in contaminated food, dust, or water from unregulated releases or accidental releases. Numerous regulations and use of pollution controls are enforced to prevent such releases.

Workers can be exposed to cadmium in air from the smelting and refining of metals, or from the air in plants that make cadmium products such as batteries, coatings, or plastics. Workers can also be exposed when soldering or welding metal that contains cadmium. Approximately 512,000 workers in the United States are in environments each year where a cadmium exposure may occur. Regulations that set permissible levels of exposure, however, are enforced to protect workers and to make sure that levels of cadmium in the air are considerably below levels thought to result in harmful effects.

Some sources of phosphate in fertilizers contain cadmium in amounts of up to 100 mg/kg[3][4], which can lead to an increase in the concentration of cadmium in soil (for example in New Zealand).[5] Nickel-cadmium batteries are one of the most popular and most common cadmium-based products, and this soil can be mined for use in them.

An experiment during the early 1960s involving the spraying of cadmium over Norwich has recently been declassified by the UK government, as documented in a BBC News article.[6]

In February 2010, cadmium was found in an entire line of Wal-Mart exclusive Miley Cyrus jewelry. The charms were tested at the behest of the Associated Press and were found to contain high levels of cadmium. Wal-Mart did not stop selling the jewelry until May 12 because "it would be too difficult to test products already on its shelves."[7]. On June 4 cadmium was detected in the paint used on promotional drinking glasses for the movie Shrek Forever After, sold by McDonald's Restaurants, triggering a recall of 12 million glasses.[8].

Clinical effects

Acute exposure to cadmium fumes may cause flu like symptoms including chills, fever, and muscle ache sometimes referred to as "the cadmium blues." Symptoms may resolve after a week if there is no respiratory damage. More severe exposures can cause tracheo-bronchitis, pneumonitis, and pulmonary edema. Symptoms of inflammation may start hours after the exposure and include cough, dryness and irritation of the nose and throat, headache, dizziness, weakness, fever, chills, and chest pain.

Inhaling cadmium-laden dust quickly leads to respiratory tract and kidney problems which can be fatal (often from renal failure). Ingestion of any significant amount of cadmium causes immediate poisoning and damage to the liver and the kidneys. Compounds containing cadmium are also carcinogenic.

The bones become soft (*osteomalacia*), lose bone mineral density (*osteoporosis*) and become weaker. This causes the pain in the joints and the back, and also increases the risk of fractures. In extreme cases of cadmium poisoning, mere body weight causes a fracture.

The kidneys lose their function to remove acids from the blood in *proximal renal tubular dysfunction*. The kidney damage inflicted by cadmium poisoning is irreversible. The *proximal renal tubular dysfunction* creates low phosphate levels in the blood (*hypophosphatemia*), causing muscle weakness and sometimes coma. The dysfunction also causes gout, a form of arthritis due to the accumulation of uric acid crystals in the joints because of high acidity of the blood (*hyperuricemia*). Another side effect is increased levels of chloride in the blood (*hyperchloremia*). The kidneys can also shrink up to 30%.

Other patients lose their sense of smell (anosmia).

Biomarkers of excessive exposure

Increased concentrations of urinary beta-2 microglobulin can be an early indicator of renal dysfunction in persons chronically exposed to low but excessive levels of environmental cadmium. The urinary beta-2 microglobulin test is an indirect method of measuring cadmium exposure. Under some circumstances, the Occupational Health and Safety Administration requires screening for renal damage in workers with long-term exposure to high levels of cadmium.[9] Blood or urine cadmium concentrations provide a better index of excessive exposure in industrial situations or following acute poisoning, whereas organ tissue (lung, liver, kidney) cadmium concentrations may be useful in fatalities resulting from either acute or chronic poisoning. Cadmium concentrations in healthy persons without excessive cadmium exposure are generally less than 1 μg/L in either blood or urine. The ACGIH biological exposure indices for blood and urine cadmium levels are 5 μg/L and 5 μg/g creatinine, respectively, in random specimens. Persons who have sustained renal damage due to chronic cadmium exposure often have blood or urine cadmium levels in a range of 25-50 μg/L or 25-75 μg/g creatinine, respectively. These ranges are usually 1000-3000 μg/L and 100-400 μg/L, respectively, in survivors of acute poisoning and may be substantially higher in fatal cases.[10][11]

See also

- Itai-itai disease

References

General

- Shannon M. Heavy Metal Poisoning, in Haddad LM, Shannon M, Winchester JF(editors): Clinical Management of Poisoning and Drug Overdose, Third Edition, 1998.

Specific

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10. ^ Nordberg GF. Biomarkers of exposure, effects and susceptibility in humans and their application in studies of interactions among metals in China. Toxicol. Lett. 192: 45-49, 2010.
11. ^ R. Baselt, *Disposition of Toxic Drugs and Chemicals in Man*, 8th edition, Biomedical Publications, Foster City, CA, 2008, pp. 212-214.

External links

- ATSDR Case Studies in Environmental Medicine: Cadmium Toxicity (http://www.atsdr.cdc.gov/csem/cadmium/) U.S. Department of Health and Human Services
- National Pollutant Inventory - Cadmium and compounds (http://www.npi.gov.au/database/substance-info/profiles/17.html)
- http://www.canoshweb.org/odp/html/cadmium.htm

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