Toxicity of lead poisoning.

Oyesiji Rilwan Oyebamiji[1], Tamar Kezeli[2], Nodar Sulashvili[3]

The University of Georgia, School of Health Sciences and Public Health[1]
Tbilisi State University, Faculty of Medicine[2]
[1]Student of pharmacy program in English[1]; [2]Supervisor, MD, PhD. Professor [2]; [3]Supervisor, Pharm. D., PhD(c)[2]

Summary

In ancient time there has been recognition of toxicity of lead among people. Today, lead and its compounds are some of the most well□studied environmental toxicants. There are Common toxic agents that have been a major concern they are heavy metals, organophosphates, bacterial, and animal neurotoxins are all toxic substances invading the human body. Generally, lead exposure is one of the most frequent and dangerous exposures that can escalate to significant neuropsychological and functional decline in the human body. Lead toxicity is a serious environmental disease and its effects on the human body are disastrous. All functions in the human body are affected by lead toxicity. In countries like US and Canada the use of lead has been controlled extensively, it is still used in large scale by developing countries. This is primarily because it has physical and chemical properties that make it suitable for a large number of applications for which humans have benefitted from. For many years lead has been a major environmental pollutant. Lead is highly persistent in the environment and because of its application in all most, all human produce its levels rise generally in almost every country causing a serious threat.

Background: Lead is a metal that as lead to a major adverse health side effects, and yet the effect of it molecular processes pertaining to it toxicity are still poorly not understood.

Methods: Research work and journals from different illustrators and authors.

Key Words: Lead, Heavy metals, lead toxicity, lead poisoning

Introduction

Toxins is a poisonous and dangerous substance generated from a living cells or organisms. The term was first used by organic chemist Ludwig Brieger (1849–1919). The term "toxin" means the toxic material or product of plants, animals, microorganisms (including, but not limited to, bacteria, viruses, fungi, rickettsiae or protozoa), or infectious substances, or a recombinant or synthesized molecule, whatever their origin and method of production. For a toxic substance not produced within living organisms, "toxicant" and "toxics" are also sometimes used. Toxins can be small molecules, peptides, or proteins that are capable of causing disease on contact with or absorption by body tissues interacting with biological macromolecules such as enzymes or cellular receptors. Toxins totally different in their severity, ranging from usually acute (as in a bee sting) and chronic (as in botulinum toxin).

Lead is highly toxic and can cause damage to the brain, kidneys, bone marrow, and other body systems in humans. Lead is the most important toxic heavy element in the environment. Due to its important physicochemical properties, its use can be retraced to historical times. Globally it is an abundantly distributed, important yet dangerous environmental chemical. Its important properties like softness, malleability, ductility, poor conductibility and resistance to corrosion seem to make difficult to give up its use. Due to its non-biodegradable nature and continuous use, its concentration accumulates in the environment with increasing hazards. Human exposure to lead and its compounds occur mostly in lead-related occupations with various sources like leaded gasoline, industrial processes such as smelting of lead and its combustion, pottery, boat building, lead-based painting, lead-containing pipes, battery recycling, grids, arms industry, pigments, printing of books, *etc.*

Manifestation and classification lead poisoning

Lead poisoning is also known as plumbism, it is a medical condition caused by increased levels of the heavy metal lead in the body. Lead interferes with a variety of body processes and is toxic to many organs and tissues including the heart, bones, intestines, kidneys, reproductive system and nervous system.

It obstructs the formation of the nervous system of the body in a large way and is therefore mostly toxic to children or neonates, causing potentially permanent learning and behavior disorders. Symptoms: Abdominal pain, confusion, headache, anemia, and irritability. Severe cases: Seizures, Coma. Acute (from intense exposure of short duration). Chronic (from repeat low-level exposure over a prolonged period).Much more common organic lead poisoning [1].

Now it is very rare, because countries across the world have passed different protective laws on the use of organic lead compounds as additives in gasoline production, but most of the compounds are still widely used in most industrial settings. Organic lead compounds that pass through the skin and respiratory tract cause a great damage to the central nervous system predominantly.

Inorganic lead poisoning. Neurotoxicity help to describes the neurophysiological changes that arise from exposure to toxic agents, which further lead to cognitive changes, memory disorders, and changes in mood or onset of psy-

psychiatric disturbance. Common toxic agents are heavy metals, drugs, organophosphates, bacterial, and animal neurotoxins. Toxic exposure can be either by acute exposure or chronic exposure. In all, neurotoxic exposure may result in central-nervous-system damage, affective disturbances, and/or neurocognitive disruptions [2].

Toxicity of lead

Neurotoxicity generated from lead toxicity is most commonly categorized into groups which are chronic or acute when the human body is exposed to it. Acute exposure often involves rapid onset of nausea, headaches, cognitive changes, and emotional disruptions. However, heavy metal exposure is often encountered in industrial workplace environments, where chronic prolonged exposure to the toxic substance is more likely. In chronic exposure, progressive loss of structure and function of neuron and psychiatric manifestations are more prevalent. Psychiatric manifestations may include increased depression, anxiety, and irritability. Chronic exposure may also aggravate symptoms, including fatigue, and generally decreased cognitive functioning. Poisoning due to lead also occurs mainly by ingestion of food or water contaminated with lead. However accidental ingestion of contaminated soil, dust or lead-based paint may also result in poisoning. Lead is said to move sporadically when absorbed into the bloodstream and is believed to have adverse effects on some organs in the body systems like the central nervous system, the cardiovascular system, kidneys, and the immune system. Most pharmaceutical companies made it possible in setting limits. For maximum daily intake of lead as 1.0 μg/g, however prolonged intake of even this low level of lead is hazardous to human beings. Being unnecessary for the human body, the prescribed limit for drinking water set by WHO is 0.01 mg/L (10 μg/L). Occupational exposure also results in elevated blood lead levels. Increased blood levels are associated with delayed puberty in girls. There is no threshold value for the level of lead present in blood below which its concentration can be considered safe. Traditional medicines were also found to contain heavy metals including lead. A number of diseases have been reported due to consumption of traditional medicine. Lead toxicity may be caused by fruits and vegetables contaminated with high lead levels from the soils where they were grown [3].

In order to prevent the general population from domestic lead poisoning, it is necessary to educate people about the major sources of lead poisoning. Lead from water pipes coming into homes is one of the major sources. For ingested lead, the rate of absorption by the body is very high with almost 20–70% and in children, it is even higher. However, the rate of skin absorption for inorganic lead is low.

In the early 1970s, 200,000 tons of lead was emitted from automobiles in the United States each year, mostly in urban areas. The lead was added to gasoline to reduce engine knock in high-compression engines, which otherwise would have required higher-octane gasoline. The oil and lead industries, including manufacturers of gasoline lead additives, had successfully thwarted government efforts to limit lead in gasoline for 50 years.

The oil and lead industries used various strategies to forestall regulation of lead in gasoline. For example, when workers involved in the initial manufacture of gasoline lead additives suffered severe lead poisoning and even deaths, the lead industry blamed the victims for failing to follow good work practices. Another strategy employed by the lead industry was to use their public relations capabilities to advertise the benefits of their products to the general public while casting doubt on the possibility of harm associated with the use of these products. This was particularly true in the case of airborne lead: The lead industry vigorously claimed that airborne lead was a negligible contributor to population lead exposure and was not a factor in excessive lead exposure in children. The lead industry was able to achieve its influence in large part by being the primary supporter of research on health effects of lead and relying upon the scientists that it supported to communicate and interpret this research to the government and the public.

Table 1. Toxicity of lead

Neurological: Learning disability Decreased IQ Mental retardation Encephalopathy Motor deficits Seizures Cerebral edema Hearing loss	Gastrointestinal: Abdominal pain Nausea Vomiting Diarrhea Constipation Anorexia Metallic taste in mouth Ileus	Renal : Tubular damage Azotemia Gou
Hematologic Affects blood synthesis Hemolysis RBC stippling Iron deficiency	Musculoskeletal Muscle and joint pain Soft tissue Blue-black line in gum margins	Endocrine Decreased stature Decreased growth hormone Decreased vitamin D levels

Etiology of lead poisoning

Lead is a metal that occurs naturally in the earth's crust. Lead can be found in all parts of our environment. Much of it comes from human activities such as mining and manufacturing. Lead used to be in paint; older houses may still have lead paint. You could be exposed to lead by eating food or drinking water that contains lead. Water pipes in older homes may contain lead. Working in a job where lead is used. Using lead in a hobby, such as making stained glass or lead-glazed pottery. Using folk medicines such as herbs or foods that contain lead [4].

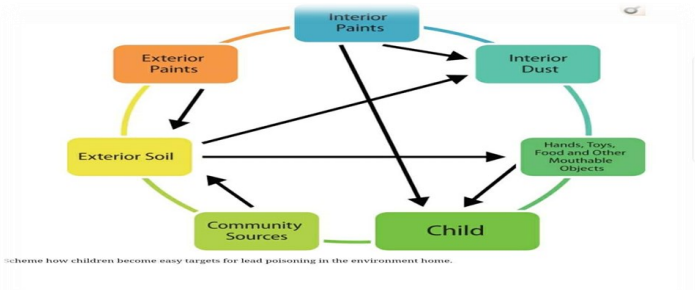
Air we breathe, drinking water, eating food, or swallowing or contact with dirt that contains lead can cause many health problems. Lead affects almost every organ and system in the body. In adults, lead can cause high blood pressure and cause infertility, nerve disorders, and muscle and joint pain. It can also make you irritable and affect your ability to concentrate and remember.

Lead is dangerous for children. A child whose intake of lead is high or extremely high may develop anaemia, severe stomach ache, muscle weakness, and brain damage. Even at a diminished levels, of contact lead can affect a child's mental and physical growth.

Effect on children

Pregnant women who have elevated blood lead levels are at a risk of premature birth or of babies with a low birth weight. The fetus may be adversely affected by blood lead concentrations well below 25 μg per decilitre. Blood lead levels in the neonate were found to be higher than simultaneous maternal lead levels. Emaciated women with substantial exposure to lead prior to pregnancy are considered to be at increased risk.

Children have been repeatedly reported to be at higher risk for lead poisoning because their bodies are in a state of growth and development. Moreover, the absorption of lead occurs more quickly in children than in adults. Children, due to their childish behaviour, are more prone to ingest and inhale dust contaminated with lead. The number of ways how children become easy targets for lead poisoning is illustrated above [5].



Scheme how children become easy targets for lead poisoning in the environment home.

Diagnosis of lead poisoning

In order to prevent lead poisoning and toxicity, proper diagnosis is a primary and rather important issue. In order to make a proper diagnosis, an inquiry about the possible routes of exposure is a must. The inquiry should include medical history and determination of clinical signs. The involvement of proper staff, *i.e.* clinical toxicologists and medical specialists, can help in establishing proper diagnosis and treatment. Several methods are used to detect elevated blood lead levels. The presence of changes in blood cells visible under the microscope or deletion of dense lines in the bones of children seen on X-ray are signs used for detecting lead poisoning. However the main tool to detect elevated levels of body lead is to measure the level of lead in blood samples. This test gives however only an account of lead present in circulating blood but cannot show how much lead is stored in the body.

Prevention and treatment

Lead poisoning portray a harmful effects and is a consequential matter of serious concern, yet importantly, it is preventable. The best approach is to avoid exposure to lead. It is recommended to frequently wash the hands and also to increase their intake of calcium and iron. Vacuuming frequently and eliminating the use and or presence of lead containing objects like blinds and jewellery in the house can also help to prevent exposures. House pipes containing lead or plumbing solder fitted in old houses should be replaced to avoid lead contamination through drinking water. It is believed that hot water contains higher lead levels than dose cold water, so it is recommended that for household uses cold water should be preferred to hot water.

The treatment for lead poisoning consists of dimercaprol and succimer. Due to the persistent findings on cognitive deficits caused by lead poisoning particularly in children, widespread reduction of exposure should be mandatory.

Lead poisoning is generally treated by using chelating salt disodium calcium edentate, which is the calcium chelate of the disodium salt of ethylene-diamine-tetracetic acid (EDTA). Such chelating agents have a great affinity to the removing agent. The chelating agent for lead has a greater affinity to lead than calcium and so the lead chelate is formed by exchange. This is then excreted in urine, leaving behind harmless calcium.

Reference

1. Academic Pathology: ‘ Lead Poisoning’ Barbara E. C. Knollmann-Ritschel, MD and Morri Markowitz, MD February 21, 2017
2. Biomed Research international: ‘Neuropsychological Effects of Lead Toxicity’ Lisa H. Mason, Jordan P. Harp and Dong Y. Han, 2 January 2014
3. Environmental Health Perspectives : ‘A Personal Perspective On The Initial Federal Health-Based Regulation to Remove Lead from Gasoline’ Kenneth Bridboard and David Hanson 15 April 2
4. International Journal of Molecular science: ‘Heavy metals and Human Health: Mechanistic Insight into Toxicity and counter Defence system of Antioxidants’. Arif Tasleem Jan, Mudsser Azam, Kehkashan Siddiqui, Arif Ali, Incho Choi and Qazi Mohd .RizwanulHaq ,10 December 2015
5. ‘Lead Toxicity’ Abu Latif Wani, Anjum Ara Jawed Ahmad Uswani, 17 April 2015
6. https://medlineplus.gov/leadpoisoning.html
7. http://www.who.int/en/news-room/fact-sheets/detail/lead-poisoning-and-health