

“Nano-Killers”.

Aluminium Toxicity in the Human Body

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ABSTRACT: In order to be in a permanent equilibrium, the human body needs small quantities of heavy metals. When heavy metals from water, air or ingested food exceed normal concentrations, they can be a real danger to the health of the individual, causing health disorders that can culminate in the death of the person. But what can happen when these small amounts of heavy metals are introduced into the body, constantly, at short intervals? If in the bone, aluminum replaces calcium in the mineralization process, can we consider that the body can gradually adapt and accept a higher concentration of heavy metals without completely attacking and destroying any organ? Can heavy metals become "invisible enemies", difficult to detect, due to events similar to other diseases? Can, also, all these reactions of the body to intoxicating, against a background of emotional disturbance, to push the subject to suicide?

KEYWORDS: aluminum, emotional disorder, heavy metals, intoxication, suicide

Introduction

Heavy metals are natural compounds of the earth's crust (Figure 1). They cannot be degraded or destroyed. They reach our body in a very small amount, along with food, drinking water and air. As essential elements, some heavy metals (e.g. copper, selenium, zinc) are vital in maintaining the metabolism of the human body. However, in high concentrations they can be toxic. The negative effects of heavy metals may result, for example, by drinking contaminated water (e.g. lead pipes), high levels of air concentration around the emitting source, or uptake via the food chain. Heavy metals are dangerous because they tend to accumulate (David 2019). Once released, the chemical compounds are taken in more or less aquatic and terrestrial organisms. They can reach levels significantly higher concentrations in comparison with the bodies which are taken abiotic compartments (Vasile 2019). Bioaccumulation means the increase in time, in biological organisms, of the concentration of the substance in an amount compared to the concentration of the substance in the environment. Compounds accumulate in living organisms when they are assimilated and stored at a higher rate than they are destroyed (metabolized) or eliminated (David 2019).



Figure 1. Classification of heavy metal (www.alsenvironmental.ro)

There are 35 metals that are in the attention of international organizations due to their presence in the workplace or in homes. Of the 35 metals, 23 are heavy metals: antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, magnesium, mercury, nickel,

platinum, silver, tellurium, thallium, tin, uranium, vanadium and zinc. It is mentioned that not all metals are harmful to the human body. Certain metals are essential in carrying out metabolic processes. The metals are different from other environmental toxins by the fact that the body does not have the ability to remove heavy metals by the usual methods. They remain solid in the body and accumulate in the kidneys, liver, bones, nails, brain and hair and lead to various kidney diseases, developmental problems such as autism, Parkinson's, Alzheimer's, cancer and in some cases cause death of the body (Popescu 2013).

The benefits of heavy metals

In small quantities, certain heavy metals are essential in carrying out metabolic processes. These metals are: iron, copper, magnesium and zinc and their different forms are naturally found in foods, fruits and vegetables or in different nutritional supplements. These elements can also be found in industrial products such as batteries, alloys, electronic components, paint, steel and others (Popescu 2013).

Toxic heavy metals

As mentioned above, many heavy metals become toxic when the body cannot eliminate the surplus. They can enter the body through water, air, direct contact with the skin or through food. The most toxic heavy metals are: aluminium, cadmium, mercury, lead and arsenic. The most common way of accessing heavy metals in the body is to ingest them. Children can reach a high level of heavy metals in the body only by inserting their fingers into their mouth after playing in a polluted environment or by ingesting non-food materials. Lead is also used as a radiation shield during X-rays (Popescu 2013).

General symptoms

Heavy metal intoxication can be life-threatening, so medical testing is very important if there are severe symptoms of heavy metal toxicity, such as impaired ability to walk, severe nausea or other important symptoms of the body and determined their concentration to establish the best course of action for detoxification of heavy metals in the system. Because the early symptoms of heavy metal toxicity may also be symptomatic of other conditions, it is vital to have adequate early tests before the symptoms worsen. Hair analysis can show exactly the harmful substances and then proper detoxification of heavy metals can be implemented (Drochioiu 2013, 57). Symptoms (cramps, nausea and vomiting, pain, sweating, headache, heavy breathing, confusion, difficulties in thinking, walking and talking and convulsions) are not difficult to recognize because they are usually severe, rapid, and may be associated with a recent event (exposure or ingestion), but, symptoms of chronic intoxication (they occur over long periods) are just as easily recognized as the others just as they closely resemble symptoms of other diseases and sometimes they can disappear and appear and thus delay the search for a treatment, the person in cause believing that the symptoms have other causes (difficulties in thinking, walking and talking, nervousness and emotional instability, insomnia, nausea and lethargy (Popescu 2013).

People can come in contact with heavy metals in industrial work, pharmaceutical industry or agriculture. Children can be poisoned when playing on contaminated soil. Lead poisoning in adults has been discovered when using lead-based glaze from ceramic vessels used for food. There is also contamination with herbal remedies. Also, the arsenal and the waist were mixed with food or drink for suicide or to poison others. The following nine elements are toxic: aluminum, antimony, arsenic, bismuth, cadmium, lead, mercury, nickel and tin. Hair can be used to determine their concentration because it accumulates heavy metals. However, literature shows that not all heavy metals accumulate in the hair. Heavy metal toxicity or poisoning occurs when the body accumulates an excessive amount of a heavy metal, such as mercury, lead, arsenic, cadmium, nickel or aluminum, thus exposing the individual to serious illness or death. These heavy metals do not play in the body. Humans have no known biological role, unlike some microelements, such as selenium, which is an effective antioxidant, iron, which is required for blood cells or copper, which is an integral part of

many enzymes. Since these metals are not useful to the body and because the body has the ability to store them, these heavy metals can accumulate in tissues over time and cause serious health problems. If symptoms of heavy metal poisoning appear, these metals should be investigated in the body with analytical methods such as colorimetric microanalysis or atomic absorption spectrometry. In the case of determining a certain degree of toxicity, it is resorted to a removal of the heavy metal by treatment with chelators or it is addressed to the doctor. However, a number of symptoms of lead or mercury poisoning may also occur in other circumstances that have nothing in common with the toxicity characteristic of heavy metals. These general symptoms include a combination of prolonged fatigue and mental confusion or lack of concentration. However, just fatigue or mental problems are not enough to suspect heavy metal poisoning. Some of the toxic heavy metals, such as lead, mercury, aluminum, are suspected in any noticeable decline in motor skills and balance. However, if the body becomes heavier and unbalanced, and this condition lasts a while, heavy metal poisoning can be excluded. Problems with balance and / or decreased motor skills are rarer than fatigue or mental confusion and may indicate other medical conditions besides heavy metal intoxication. Therefore, the specific symptoms of heavy metal poisoning must be detected (Drochioiu 2013, 56-57).

Sources of heavy metals for plants, animals and humans

The presence of toxic metals in our body is very important because they are capable of causing serious health problems, because they interfere with normal biological functioning. Although these metals can be found in high concentrations in the body, a number of heavy metals (aluminum, beryllium, cadmium, lead and mercury) have no known biological function. Others (arsenic, copper, iron and nickel) are considered to be essential in low concentrations, but are toxic at high concentrations. Heavy metals disrupt metabolic functions in two ways: 1) they accumulate and therefore disrupt the function of vital organs, such as the heart, brain, kidneys, bones, liver, but also the glands of the body; 2) they replace the vital nutrient minerals in the body, where they fulfill a biological function (Drochioiu 2013, 60).

Air can be a source of contamination representing a way of transporting metals and depositing them on the ground, plants (e.g. lead emission from cars). Heavy metal air pollution is the result of numerous anthropogenic activities: coal combustion, oil production, non-ferrous metals production, steel and iron production, cement production. **Soil** can be another sources of metals, for example the use of fertilizers, pesticides containing metals (fungicides containing mercury, copper, arsenic, zinc). Depending on soil type and geographical location, it contains high amounts of heavy metals or may be deficient in them. **Water** can be an important source of contamination, as a result of the discharges, the activity of the sewage and pre-treatment stations, the discharge of sewage, the household waste. The hardness of the water and the content of organic compounds can lead to its enrichment with the lead from the crossed pipes. Also, an important source of contamination with heavy metals of food may be **contact** with machines, installations or processing machines, preserving preserves in metal packaging. There are also **accidental sources**: the use of containers and pipes in underground installations for the manufacture of crackers, the use of different compounds of heavy metals for spoilage. For humans, an important source of intoxication is also the specific of the workplace, leading to the appearance of professional diseases in certain industries (Graduo.ro 2019a). From **household products** (aluminum cooking vessels), or **cosmetic products** (antiperspirants, shampoos, makeup, toothpaste, tattoos, talcum powder) to the **traces of airplanes** left in the sky or sunscreen creams, all these contain traces of heavy metals. **Vaccines** are also a source of heavy metals, aluminum, more precisely - it is injected directly into the bloodstream and can cause neurological problems. Other sources: fish (salmon, tuna, swordfish), mercury thermometers (if broken), cheap electric bulbs (if they break), pesticides, benzene, tobacco, food additives, drugs (Echim 2016; Core Inergetix 2019).

Heavy metal intoxication

Heavy metal poisoning is the toxic accumulation of heavy metals in the soft tissues of the body. The most commonly involved in accidental poisoning and poisoning are lead, mercury, arsenic and cadmium. More recently, the waistline has attracted media attention as the poison used in crime cases in the 1990s. Some heavy metals, such as zinc, copper, chromium, iron and manganese are needed in the body in small amounts, but the same elements can be toxic in larger quantities. Heavy metals can enter the body through food, water, air or through absorption through the skin. Once it reaches the body, it competes and replaces essential minerals, such as zinc, copper, magnesium and calcium and interferes with the vital functions of the body's organs. One form of mercury poisoning, common in the United States is self-injection of mercury under the skin. Some boxers inject themselves with mercury in the belief that they increase their muscle mass. Metallic mercury is also used in folk medicine or in religious rituals in different cultures. These practices increase the risk of mercury poisoning of children in these ethnic groups or subcultures (Drochioiu 2013, 58).

Over the past 50 years, exposure to heavy metals has increased dramatically. Every day, we are in contact with them, whether it is air, water we drink or food. Chronic exposure to these harmful toxins comes from the chemical residues present in processed foods, toxins from personal care products, lead from paint and tap water; mercury leads from the dentist, the workplace environment (welders, workers, painters), dental technicians and dentists, metallurgy workers, engravers, photographers, potters, printers, cosmetics and many others). Some people may remove these toxins from the system, but others, especially those with chronic health problems, tend to develop metal accumulation. In addition, heavy metals can accumulate in the body over time, which leads to symptoms that may not lead you to heavy metals. Often, the symptoms caused by metal toxicity are misdiagnosed as depression, chronic fatigue syndrome, multiple sclerosis and autism (Onciu 2017).

The severity of the toxic effect is dependent on the nature, the quality and the chemical form under which the metal is found in the food product, the weight that the contaminated food has in the structure of the menus, the resistance of the organism, the synergistic or antagonistic effect of other chemical contaminants and other factors. An important property that determines the degree of toxicity for the body is the solubility of metals and metal compounds. Gastric juice, intestinal juice, blood contain salts, acids, bases, fats, so the solubility of metals and compounds in these liquids may be different from their solubility in water. Some metals begin to exert their harmful action only after they have accumulated in the body in a sufficient quantity. They are retained in the tissues and each new quantity of substance introduced into the body is added to the old one, and at a certain moment, when a sufficient quantity has accumulated, the disease starts. Another mode of action of toxic metals is by accumulating the effect, which is manifested by the fact that, always acting on the same tissues and each new quantity of substance introduced into the body is added to the old one, and at a certain moment, they become very sensitive and the penetration of even a very low dose of the toxic substance triggers the process of intoxication (Graduo.ro 2019b).

Heavy metal poisoning is a condition that requires emergency treatment and can endanger the patient's life. It can manifest both in acute and chronic form, the signs and symptoms being different depending on the metal with which the poisoning occurred. The treatment consists of emergency steps that help to eliminate the effects and eliminate the metal from the body. Poisoning occurs as a result of prolonged exposure in an environment impregnated with such metals or as a result of accidental or willful ingestion. The body has a series of "filters cleaning" that specialize in removing heavy metals from the body without causing any damage its functioning. When a large amount of heavy mattresses enter the body or especially when the person exposed to such a toxic environment suffers from a chronic disease or immune system, the harmful substances fail to be completely eliminated by remaining in the body and causing serious harm. The ways of penetrating the heavy metals in the body are represented by their inhalation, swallowing or even passive penetration through the skin and mucous membranes. When exposure to heavy metals is continuous but their concentration is low, the person may develop chronic heavy metal poisoning over time.

But if exposure is done in an environment concentrated in such substances, the poisoning is acute and becomes much more dangerous, which could endanger the patient's life (Lataifas.ro. 2014).

Heavy metal poisoning occurs mainly by accidental contact of the body with different heavy metals, in the industrial environment or at home. The penetration of the heavy metals is by ingestion or by inhalation, or by contact with the skin, but in most situations, by chronic exposure, but also acutely. The metals are inhaled in the form of powders, smoke or vapours. When metals are ingested through contaminated foods or beverages, their gastrointestinal absorption varies greatly depending on the specific chemical form of the metal and the particularities of the body. After absorption, the heavy metal passes into the bloodstream and is subsequently confined to different organs (bones, liver, kidneys), where it achieves relatively high concentrations for years. Most metals are eliminated renal and / or gastrointestinal, but there are different metals, which are eliminated particularly in saliva, perspiration, expiration, lactation, nails or hair. Regardless of the type of heavy metal with which the poisoning occurs, the first therapy strategy is to interrupt the exposure, concomitantly with the administration of the specific chelating agents (Scribd.com 2019).

Heavy metal poisoning has become topical, with the industrialization and mechanization of human activities. It can be produced by ingestion, inhalation or direct contact. The main sources of intoxication can be: metal boxes (doses of juice, preserves), aluminum foils, chemically treated vegetables and fruits. Metals such as iron, zinc, copper, chromium and cobalt are essential for health, but even in large quantities, they become toxic. In contrast, mercury, lead, aluminum and cadmium are non-essential and dangerous, even in moderate quantities. Heavy metals are dangerous because they are bioaccumulative, their concentration increases over time, being stored in fat (Vasile 2019).

From a chemical point of view, in the heavy metals category there are almost 40 metals that have a harmful effect on food if they come in contact with them. In more common terms, this category of "heavy metals" includes the most toxic metals. Heavy metal toxicity is the result of their binding to important enzymatic systems in the animal cell or to certain components of cell membranes. Heavy metals are associated, as secondary factors, to complex pathological processes encountered in humans and animals. The toxic effect is manifested when exceeding a certain threshold below which some (Co, Cu, Fe, Ni, Zn) may even be essential components of proteins involved in different metabolic pathways. Thus, if food were completely devoid of metals then nutritional deficiencies would occur. Heavy metals are found in different concentrations in soil, water, air, food of plant or animal origin, depending on different factors that cause their pollution (www.graduo.ro).

It has been known for decades that metals accumulate in the hair and can be detected weeks or even months after the initial exposure. Numerous articles describing the detection of heavy metals in hair have been published. More recent investigations have focused on using hair as a sample for drug use detection. Analytical techniques have also been developed to prepare the sample and to allow a serial analysis of the drugs using several milligrams of hair. In theory, hair analysis for the detection of addictions offers more benefits than the use of other body fluids (Drochioiu 2013, 52).

For the detection of the heavy metals existing in our body the most relevant is the analysis of the hair (tissue mineral analysis). Blood or urine tests are not conclusive because heavy metals accumulate in the fatty tissue, hair and nails (Echim 2016).

Although toxic metals can be found in high concentrations in the body, a number of them (aluminum, beryllium, cadmium, lead and mercury) have no known biological function. Others (arsenic, copper, iron and nickel) are considered to be essential in low concentrations, but are toxic at high concentrations. In general, heavy metals disrupt metabolic functions in two ways: First, they accumulate and therefore disrupt the function of vital organs, such as the heart, brain, kidneys, bones, liver, etc., but also the glands. Second, they replace vital nutritional minerals that fulfill a biological function. For example, enzymes are catalysts for biochemical reactions, and metabolism, representing all of the chemical reactions in the body, supports the processes of life. But instead of calcium from an enzyme, lead or cadmium may enter. Toxic metals cannot play the same role as

nutritional minerals, so their presence becomes disruptive to enzyme activity. Due to their impact at such a fundamental level, heavy metals can be morbidity factors. At work or in other life circumstances exposure to heavy metals should be minimized or even eliminated. There are several ways these toxic compounds can be absorbed into the body - through food and beverages, skin exposure, or inhaled air. Whenever possible, wear gloves, use respiratory protection devices, and provide fresh air ventilation (Drochioiu 2013, 60).

Chronic exposure tends to produce symptoms that are much more easily confused with symptoms of other conditions and, as they develop over time, are more difficult to recognize due to the toxicity of heavy metals. Because toxic metals block the absorption and use of essential minerals, they can bring on an avalanche of symptoms that gradually worsen over time (Onciu 2017).

Signs of chronic exposure

Symptoms vary, depending on the nature and amount of heavy metals ingested. Patients may complain of nausea, vomiting, diarrhea, stomach pain, headache, sweating and a metallic taste in the mouth. Depending on the metal, there may be blue-black lines in the soft tissues. In severe cases, patients have obvious cognitive, motor and linguistic incompetence. The expression crazy on the head comes from the mercury poisoning spread in the 17th century in France, among the makers of hats that soaked the skin of animals in a solution of mercury nitrogen to soften their hair. They poisoned themselves over time and had specific dementia symptoms (Drochioiu 2013, 58).

In the long term, physical, muscular and neurological degenerative processes can be reached, they can mimic the symptoms associated with Alzheimer's disease, Parkinson's disease and multiple sclerosis, produce premature aging, without the realization that exposure to heavy metals is the real cause (Core Inergetix 2019).

Chronic failure, that is, a general feeling of fatigue, illness and discomfort; Chronic pain, especially in tendons, muscles or soft tissues of the body; Fog on the brain (confusion and amnesia); Digestive problems such as constipation, bloating, gas, diarrhea, heartburn or indigestion; Dizziness; Migraines or headaches; Amendments to the provision; Visual disorders; Depression or anxiety; Nervous system disorders such as numbness, tingling, burning or paralysis of the extremities; Reproductive problems in women, such as infertility, pregnancy loss and menstrual; Neurological disorders, concentration problems, learning difficulty and poor memory, recovered after intellectual; Depression or anxiety, effort problems; Decreased motor control, hearing, speech, sight and walking; Chronic fatigue, weakness, poor recovery after physical exertion, insomnia (Onciu 2017; Core Inergetix 2019).

The conditions that can be triggered by an increased level of heavy metals in the body are among the most serious: Cancer; Kidney disease; Liver disease; Autism; Autoimmune diseases; Joint disorders; Nervous system disorders; Neurodegenerative diseases such as Parkinson's or Alzheimer's; Endocrine disorders; Deformities of the fetus during pregnancy; Allergies (Echim 2016).

Aluminium

As far as heavy metals are concerned, the body does not have the capacity to eliminate them by the usual methods. They remain solid in the body and accumulate in the kidneys, liver, bones, nails, brain and hair, causing various kidney diseases, developmental problems such as autism, Parkinson's, Alzheimer's, cancer, and in some cases cause the body's death. The most toxic heavy metals are: **aluminum**, cadmium, mercury, lead and arsenic. The most common way of accessing heavy metals in the body is to ingest them. Symptoms of heavy metal poisoning are easy to recognize because they are usually severe, rapid, and may be associated with a recent event (exposure or ingestion). We are talking about cramps, nausea and vomiting, pain, sweating, headaches, heavy breathing, confusion, difficulties in thinking, walking and talking and convulsions (Laboratoarele ALS Life Sciences n.d.).

Aluminum is one of the most widespread trace elements in the earth's crust (8% of all minerals), occupying the third place after oxygen and silicon. The daily intake of aluminum by food has large variations, depending on the diet. According to O.M.S, the intake of aluminum for adults is 7 mg / kg body weight / week, i.e. 65 mg / day and for children 2 mg / kg (David 2019).

Aluminum is a chemical element (metal), found in nature (food, air, water, medicines, cosmetics) in various forms and introduced into the body by inhalation, ingestion and trans-dermal. The largest amount of aluminum reaches our body through the digestive system. At the body level, aluminum affects the metabolism of calcium, phosphorus, iron, fluorine, which is why ingestion of a large amount of aluminum is considered to be associated with the risk of Alzheimer's and Osteoporosis (Reginamaria.ro 2019; Kaplan and Sadock, 34-35).

Aluminum in the body above the allowed limit can cause: allergies, arthritis, muscle pain, extreme fatigue, lack of concentration, neuron-vegetative disorders, autoimmune diseases, depression, insomnia, muscle cramps, low potency (Munteanu 2019).

People who are overexposed to aluminum may have encephalopathy, a demented form characterized by convulsions, tremors, psychosis and various changes in speech and behavior. Encephalopathy, as a result of excess aluminum exposure, is most commonly encountered in patients who are on dialysis. Aluminum uptake may cause anemia, osteoporosis (soft or sausage-bearing bones, due to deep disturbances in phosphorus and alkaline metabolism in bone mass), and heart attacks. Aluminum is also associated with other bumps that affect the nervous system, such as Lou Gehrig's and Parkinson's. But the most feared are pre-senile dementia, mental disorders, premature aging and Alzheimer's (Academia.edu n.d.).

Aluminum is a ubiquitous metal. The following keywords indicate **The role of aluminum**: alum, aluminum foil, animal feed, antacids, aspirin, car, powdered decoction, beer, bleached flour, cans, ceramics, cheese, cigarette filters, color additives, building materials, dishes, cosmetics, dental amalgams, deodorants, drinking water, drying agents, dust, insulated cables, medicinal compounds, dairy products, nasal spray, pesticides, pollution, salt, tap water, tobacco smoke, toothpaste, treated water, powdery mildew and also **The effects of aluminum**: ALS, Alzheimer's disease, anemia, loss of appetite, behavior problems, cavities, colds, colitis, confusion, constipation, dementia, dry mouth, dry skin, loss of energy, excessive sweating, flatulence, headache, burns, hyperactivity, inhibition of enzymatic systems, renal dysfunction, reduced immune function, learning disability, leg muscle spasms, liver dysfunction, memory loss, neuromuscular disorders, numbness, osteoporosis, paralysis, Parkinson's disease, peptic ulcer, active peptic ulcer, psoriasis, senility, skin problems, spinal pain, stomach aches and weak muscle aches (Drochioiu 2013, 61).

Conclusions

A real danger to our health can be heavy metals. When they exceed certain concentrations they can seriously harm us even if some of them are needed in very small quantities. We can consider that, heavy metals are "invisible enemies", that attack our health through the air we breathe, the water we drink or the foods we consume. The big danger is that the heavy metals have no smell, taste, color and it accumulates in the body over time, their elimination is slow and difficult and the intoxication is very difficult to detect because the manifestations are similar to those of other diseases.

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