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# "Heavy metals toxicity and its effect on human health"

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**Abstract:**

Heavy metal poisoning is the exposure of heavy metal toxins to human body in smaller scale which then accumulates and in the body being exposed increasing the concentration of these heavy metals leading to various health hazards. Some heavy metals are lead, mercury, arsenic, cadmium etc. these metals are abundantly and naturally present in the environment and almost a large population is exposed to these metals, but depending on the amount and type of heavy metal exposed humans are affected accordingly. In past years a lot of diseases have been reported caused due to heavy metal toxicity leading to a large number of lives being lost. Heavy metals prevents the cells in the body affected by these metals to function properly binding them from doing their job, it can be life threatening and causes permanent damage to human health, there are many sources and many are man-made like industrial processes, mining etc. numerous health hazards occur in human body which stays with the patient for a very long time. The presence of these heavy metals in environment causes a lot of harm to the environment as well. In today's generation, the concentration of these metals have increased constantly and leaves a huge impact to human population. Some toxins are arsenic, cadmium, lead, chromium and nickel, heavy metals are characterized by their high atomic mass and toxicity. Nanotechnology based experiments are being developed, as an emerging field, nanotechnology is making its advances in the analyses and removal of heavy metals from complicated matrices.

**Introduction:**

Heavy metal toxicity is the overexposure of the body of any living organism to harmful metal substances.


These heavy metals are naturally present in the environment and can be easily found in places such as ones house surroundings, workplaces, and places that people usually go to. Over exposures and even moderate amount of exposure to these metals can risk health problems in human depending on the exposure.

Some examples of the health risks are as follows:

1. Cancer
2. Can affect the production of RBCs and WBCs in the blood
3. Encephalopathy
4. MODs
5. Hemorrhage
6. Cardiac depression
7. Bone marrow suppression
8. DNA damage
9. Protein aggregation

And so on.

Heavy metals are metals that have high density compared to water which is 997kg/m$^3$. Having an atomic number greater than 20. These metals are highly toxic and damages environment, out of 10 major pollutants in the world according to The WHO( The World Health Organization ) four Heavy metals also made the list. The source of these metals are industrial, agricultural, pharmaceutical, domestic and environmental sources, normally these metals are naturally found throughout the earth's crust but due to the contamination of the environment due to many man-made factors such as anthropogenic activities in industries, mining operations and the usage of certain metals in the household too contribute as a source.

In biological terms, these heavy metals affects cell membrane and important components of the cell such as mitochondria, nuclei, lysosome etc and also some enzymes involved in metabolism, detoxification and damage repair, DNA and nuclear proteins are also affected. When a heavy metal is exposed into the environment for example the air, water or soil, these heavy metals are absorbed by the plants, trees, crops, underwater organisms and microorganisms which are further consumed by animals which intoxicates the entire organisms in the food chain, resulting in the lot of damage to their health. Metals such as Co(cobalt), Cu(copper), Cr(chromium), Fe(iron0, Mg(magnesium), Ni(nickel), Se(selenium) and Zn(zinc) are important nutrients needed in various biochemical and physiological functions, less or more of these metals causes various deficiency syndromes. The essential heavy metals exert certain biochemical-physiological functions in plants and animals, they are essential parts of many key enzymes, therefore plays a very important role in oxidation-reduction reactions.

**Heavy Metal Toxins**

**Arsenic (As)**: the most important heavy metal.

**Atomic no: 33**

Arsenic is a naturally occurring metalloid found in air, water and soil, it comes in two forms which are organic and inorganic out of which the inorganic is more toxic. It is released in to the environment by certain agricultural and industrial processes. It also has a specific gravity, Arsenic is the $20^{th}$ most abundant element on the earth's crust and is very well known as one of the few metals and metalloids which causes damage in a large scale with adverse health effects.

It is estimated that several million people in the world are exposed to arsenic, especially in countries like India, Taiwan, Mexico, Bangladesh where large number of ground water is contaminated by it, causing various clinico-pathological conditions including cardiovascular and peripheral vascular disease, developmental anomalies, neurologic and neurobehavioural disorders, diabetes, hearing loss, portal fibrosis, hematologic disorders and carcinoma. Arsenic is exposed to a human by various contacts such as oral ingestion, inhalation by nose and dermal contact. Diet is the largest source to many individuals, while intake from air, water and soil are lesser in comparison. Individuals in occupation as vineyards, ceramics, glass making, smelting, refining of metallic ores, pesticide manufacturing and application, wood preservation can be exposed to substantially higher levels of arsenic. Human exposure at waste or dumping sites may enter the human body through inhalation of dusts in the air, ingesting the contaminated water or soil through food chain. Arsenic exposure effects virtually all organs including the cardiovascular system, dermatologic system, nervous system, hepatobilliary, renal, gastro-intestinal, and respiratory systems. In many arsenic polluted areas research has also shown significantly higher rates of cancer of the bladder, kidney, skin, and liver.

The toxicity of arsenic is very complicated because it is influenced be its oxidation state and its solubility and many other intrinsic and extrinsic factors. One of the means by which arsenic wields its toxic effect is through impairment of cellular respiration by the inhibition of various mitochondrial enzymes and the uncoupling of oxidative phosphorylation, and its ability to interact with sulfydryl groups of proteins and enzymes.

**Symptoms of Arsenic poisoning:**

Symptoms of arsine toxicity include garlic breath odor, headache, nausea, vomiting, diarrhea, chest pain, loss of balance, tachycardia, fever, and renal failure 1 to 12 hours after exposure. Four to 48 hours after exposure, port wine hue urine, reddish stained conjunctiva, and jaundice describe as "slate-bronze skin" has been reported. Physical examination may reveal liver, spleen tenderness. Direct effect on the myocardium can occur which may relate to conduction disorders, heart block and asystole.

**Chronic Effects in Human health**

- Arsenic exposure has links to basal cell carcinoma, as well as squamous cell carcinoma secondary to hyperkeratosis. Skin cancer in arsenic exposure has presented in sunless exposure on palms, soles, and abdomen
- Hepatic system: Arsenic has links to angiosarcoma, hepatomegaly, ascites, and non-specific abdominal pain
- Reports exist of gangrene of extremities also called "Blackfoot disease" from contaminated drinking water in Taiwan.
- Lung and bladder cancer also have correlations with exposure to inorganic arsenic.

**Treatment:**

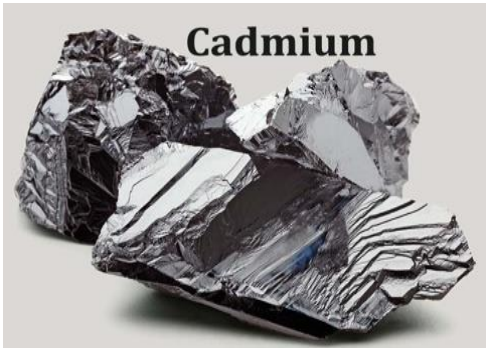
Arsenic toxicity is a life-threatening condition and mandates aggressive treatment with particular attention to fluid resuscitation, blood pressure support, and cardiac monitoring. Patients requiring hospitalization should be in the ICU for advanced life support monitoring. Chelation therapy has been shown to improve outcomes if started in minutes to hours after arsenic exposure

**Cadmium (Cd)**

**Atomic no: 48**

Cadmium is a soft, malleable white metal found in zinc ores, its compounds are very toxic in nature, it does not have any odor or taste. Industrially it is used in batteries, alloys, solar cells, plastic stabilizers, and pigments. It is also used in nuclear reactors acting as a neutron absorber. It is an important metal for businesses and industrial

processes and hence the exposure to cadmium occurs mostly in work places by inhalation of dust and fumes and incidental ingestion of dust from the contaminated hands, cigarettes, food.




Smoking cadmium contaminated tobacco is another way to be exposed to the metal, the passive smokers are also affected by it. When Cadmium was tested in the blood samples of smokers, it showed that they had 4-5 times more Cd level in their blood than that of the non smokers. Lungs are very much damaged by this metal especially in Cd- exposed workers reported as early as 1930's, and hence in the later years bone and kidney toxicity cases were also reported. Cadmium causes birth defects and also causes cancer. It is toxic, carcinogenic and teratogenic in nature, it can be measured in the blood samples, urine, hair, nails and in saliva samples.


**Fig:** Patient affected by Itai-Itai disease

Itai-itai disease is an example of a chronic disease caused due to Cadmium contamination in Japan in the 1960's, it was characterized by osteomalaccia with severe bone pain and is associated with renal tubular dysfunction. It mainly affected the women residing in rice farming areas irrigated by the contaminated Jinzu river in Toyama, Japan. The contaminated rice and drinking water was the main source that lead to the poisoning, patients of Itai-Itai disease demonstrated a Cd body burden, indicated by Cd concentrations in the liver that is remarkably higher than subjects in non polluted areas.

**Chromium (Cr)**

**Atomic no: 24**

Chromium is a steely grey, lustrous, hard and brittle transition metal, it is the first element in group 6 of the periodic table. Chromium is widely found in the environment, trace amounts of chromium is found in rocks and soil, fresh water and ocean water, in the foods that we eat and in the air we breathe. It is used in paints, dyes, wood preservatives, rust inhibitors, and many products that we see and use in our day to day life. Chromium is predominantly used for the production of stainless steel and in chrome plating. It is also used in medicine to tag or to lable red blood cells in the blood of a human body, labeling is permanent hence is an important way to look at long term patterns of blood cell turnover in the body, to look for evidence of internal bleeding and for similar studies.

**Mercury (Hg)**

**Atomic no: 80**

Mercury is a naturally occurring element found in air, water and soil, it occurs naturally in the earth's crust and is released into the environment from volcanic activity, weathering of rocks as a result of human activities such as coal burning for cooking in households, industrial activities, waste incinerators and mining for gold, mercury and other metals. It is used in thermometers, barometers, sphygmomanometers, float valves, fluorescent lamps and other devices.

When mercury is exposed to the environment, it gets transformed by bacteria from mercury to methylmercury which then bioaccumulates in fish and shellfish. And the main source to mercury exposure is by ingesting fishes and shellfish highly contaminated by mercury, people who fish and through air inhalation by workers in industries with mercury production. All human beings are exposed to mercury but fatal diseases in humans depend on how much one is exposed to the metal. Some factors that determine the severity of health effects are:

- Type of mercury absorbed.
- Dose.

- Age of the exposed person (fetus are more susceptible, the exposure to Methyl mercury while fetus in womb can adversely affect the baby's growing brain and nervous system)
- Duration of exposure.
- The route of exposure, for example; through inhalation, ingestion or dermal contact.

Methyl mercury primarily affects central and peripheral nervous systems. It can produce harmful effects on the nervous systems, lungs and kidney affecting cognitive thinking, memory, attention, language, fine motor and visual spatial skills maybe affected in children. It may be fatal when ingested which is then corrosive to the skin, eyes and gastrointestinal tract.

**Symptoms:**

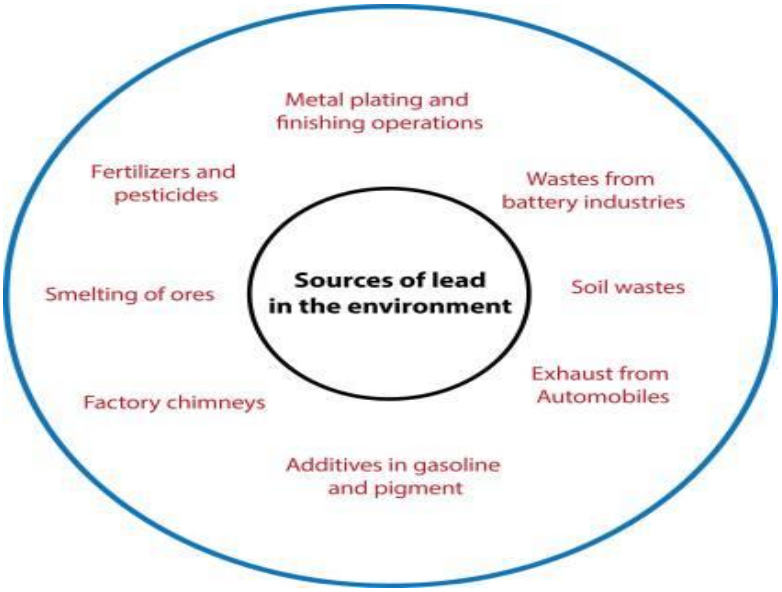
- Tremors
- Insomnia
- Memory loss
- Neuromuscular effects
- Headaches
- Cognitive and motor dysfunction

**Lead (Pb)**

**Atomic no: 82**

Lead is a bluish-grey metal present in the earth's crust, activites such as fossil fuels burning, mining highly contributes in the release of lead to the environment in higher concentration. It has many industrial, agricultural and domestic applications, it is widely used for car batteries, ammunition, cable sheathing, weights for lifting, radiation protection, it is often used to store corrosive liquids.

Lead is an extremely toxic heavy metal that disturbs various plant physiological processes and unlike other metals, such as zinc, copper and manganese, it does not play any biological functions. A plant with high lead concentration fastens the production of reactive oxygen species (ROS), causing lipid membrane damage that ultimately leads to damage of chlorophyll and photosynthetic processes and suppresses the overall growth of the plant.




**Mechanisms of lead toxicity**

Lead metal causes toxicity in living cells by following ionic mechanism and that of oxidative stress. Many researchers have shown that oxidative stress in living cells is caused by the imbalance between the production of free radicals and the generation of antioxidants to detoxify the reactive intermediates or to repair the resulting damage.fig 3 shows the attack of heavy metals on a cell and the balance between ROS production and the subsequent defense presented by antioxidants. Antioxidants, as *e.g.* glutathione, present in the cell protect it from free radicals such as $H_2O_2$. Under the influence of lead, however, the level of the ROS increases and the level of antioxidants decreases. Since glutathione exists both in reduced (GSH) and oxidized (GSSG) state, the reduced form of glutathione gives its reducing equivalents ($H^+ + e^-$) from its thiol groups of cystein to ROS in order to make them stable. In the presence of the enzyme glutathione peroxidase, reduced glutathione readily binds with another molecule of glutathione after donating the electron and forms glutathione disulfide (GSSG). The reduced form (GSH) of glutathione accounts for 90% of the total glutathione content and the oxidized form (GSSG) accounts for 10% under normal conditions. Yet under the condition of oxidative stress, the concentration of GSSG exceeds the concentration of GSH. Another biomarker for oxidative stress is lipid peroxidation, since the free radical collects electron from lipid molecules present inside the cell membrane, which eventually causes lipid peroxidation At very high concentrations, ROS may cause structural damage to cells, proteins, nucleic acid, membranes and lipids, resulting in a stressed situation at cellular level

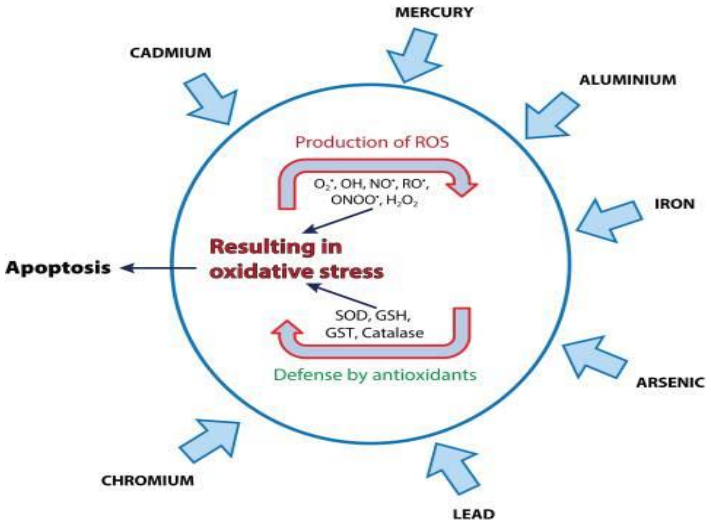



**Fig:** attack of heavy metals on cells.

The ionic mechanism of lead toxicity occurs mainly due to the ability of lead metal ions to replace other bivalent cations like Ca2+, Mg2+, Fe2+ and monovalent cations like Na+, which ultimately disturbs the biological metabolism of the cell. The ionic mechanism of lead toxicity causes significant changes in various biological processes such as cell adhesion, intra- and inter-cellular signaling, protein folding, maturation, apoptosis, ionic transportation, enzyme regulation, and release of neurotransmitters. Lead can substitute calcium even in picomolar concentration affecting protein kinase C, which regulates neural excitation and memory storage.

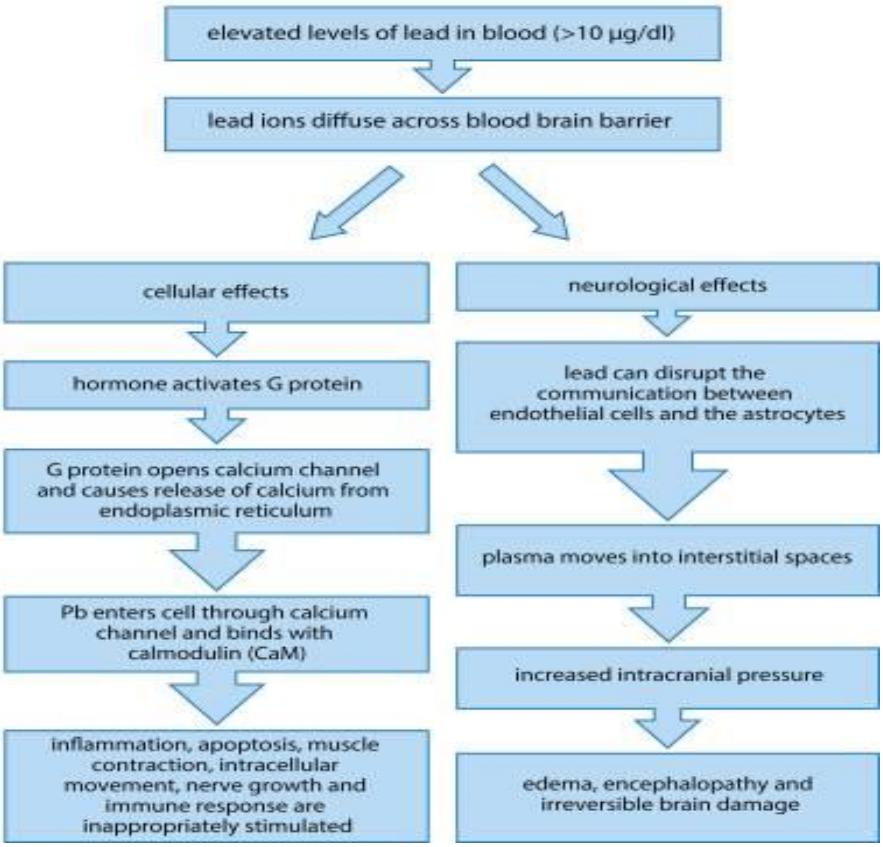


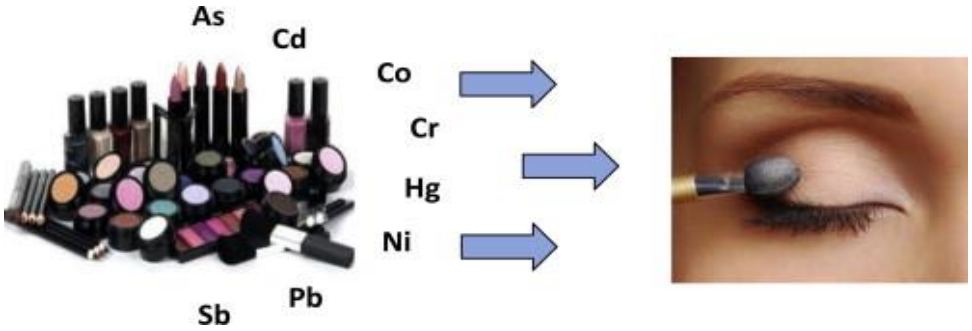

**Fig:** effects of lead in blood.

**Effects of heavy metals on humans**

There are 35 metals that are of concern for us because of residential or occupational exposure, out of which 23 are heavy metals: antimony, arsenic, bismuth, cadmium, cerium, chromium, cobalt, copper, gallium, gold, iron, lead, manganese, mercury, nickel, platinum, silver, tellurium, thallium, tin, uranium, vanadium, and zinc (Mosby et al. 1996). These heavy metals are commonly found in the environment and diet. In small amounts they are required for maintaining good health but in larger amounts they can become toxic or dangerous.

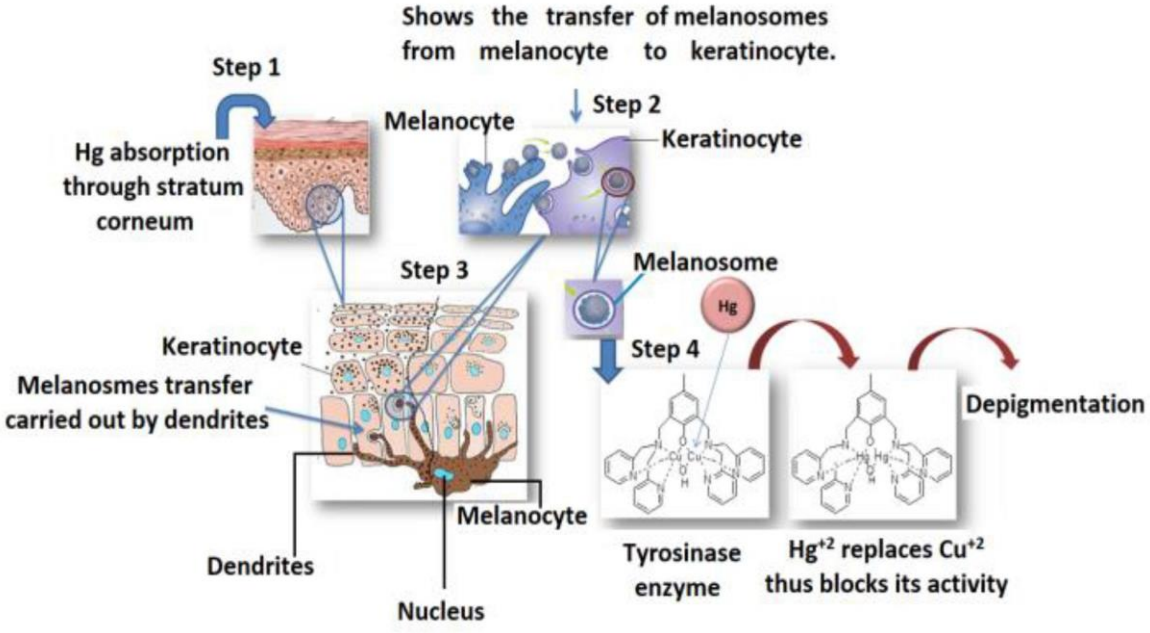
Heavy metal toxicity can lower energy levels and damage the functioning of the brain, lungs, kidney, liver, blood composition and other important organs. Long-term exposure can lead to gradually progressing physical, muscular, and neurological degenerative processes that imitate diseases such as multiple sclerosis, Parkinson's disease, Alzheimer's disease and muscular dystrophy. Repeated long-term exposure of some metals and their compounds may even cause cancer (Jarup, 2003). The toxicity level of a few heavy metals can be just above the background concentrations that are being present naturally in the environment. Hence thorough knowledge of heavy metals is rather important for allowing to provide proper defensive measures against their excessive contact.

**Heavy metals in cosmetics**




Remarkable route for penetration of cosmetic ingredients is skin dermas which primarily protect sub-dermal and internal body organs. The application of cosmetics products on external skin reach the cell environment through hair follicles, sweat pores and finally blood capillaries for the function for which to be chosen Heavy metals, which are present particularly in colored cosmetics, may be there either intentionally, or as impurities introduced through raw materials that are used in the production process. According to Regulation No 1223/2009 of the European Parliament and of the Council, the presence of heavy metals (comprising Cd, Pb, As, Ni, Cr and Hg) in cosmetic products is considered dangerous for human health. However, some of these elements are added to cosmetics in order to support the proper metabolic and physiological functioning of the skin, and the regulations clearly state the permissible content of these heavy metals. Among the products that contain the above-mentioned metals are those that are applied to the mucous membrane, such as lipsticks and lip glosses, beauty creams and lotions, but also hair care products.

The presence of lead in cosmetics is strictly prohibited in cosmetics, It can be introduced into the body through the digestive and respiratory tracts or absorbed through the skin or mucous membranes. Research has shown that permanent exposure to even low levels of lead can cause eczema and skin contact allergies. The use of eye creams, as well as color cosmetics that contain lead, may contribute to high lead concentrations in the blood showed that two of the twelve tested cosmetics had lead concentrations that exceeded the limit proposed by FDA (maximum level of 20 ppm). A brief step wise transformation of Hg after applying over skin is shown in fig given below



It is difficult for inorganic mercury to cross the blood barrier to enter the central nervous system, gastrointestinal tract or multiple organs, however prolonged application over skin lead to the accumulation in central nervous system as a consequence induce various behavioral and neurological impairments. Gastrointestinal damage causes nausea, gingivostomatitis, metallic taste and hyper salivation. According to WHO over accumulation of Hg can cause leukemia, liver damage and kidney cancer. Arsenic is used as a pigment in color cosmetics used in eye shadows, lipsticks and is also present in many cosmetic and skin care products, such as lotions.. For arsenic the limit is 3 ppm. The use of arsenic in its inorganic form may have many side effects, such as fatigue, nausea, vomiting, skin diseases and cancer. In a study conducted in 2017 on 20 different types of cosmetics, arsenic was detected in skin foundation, lip balm, skin whitening cream, and hair dyes. The highest concentration of arsenic was found in lip balm (19.55 ppm).

Skin foundations and lightening creams are also sources of another toxic metal wich is mercury. Mercury may be found in cosmetics in two forms: organic (thimerosal), used as a preservative, and inorganic ($HgCl_2$), used in skin lightening creams, which can be combined with other elements, such as oxygen, sulfur and chlorine. However, mercury compounds are allowed in cosmetics only as preservatives. Numerous reports have indicated that mercury is still used in cosmetic products in countries such as Mexico, US, Africa and Asia. Many of the tested cosmetics exceeded the acceptable limit established by the WHO and the FDA (it should be no more than 65 parts per million (ppm) in the finished product). Scientific studies have shown that people exposed to skin-lightening creams exhibit increased levels of mercury in their body.

Therefore, long-term use of cosmetics that contain even small amounts of mercury can cause kidney damage, skin damage in the form of discoloration or allergic changes, as well as peripheral neuropathy. Reports of mercury poisoning have also been documented in pregnant women and in children. A case has been described of a four-year-old girl from Iraq, who after three months of applying whitening cream, showed symptoms of mercury poisoning. The child's symptoms included loss of appetite, seizures, weight loss, weakness, and body rash. Her urine mercury levels were significantly above the generally accepted standard. Additionally, studies conducted on women in the third trimester of pregnancy who used whitening creams displayed mercury concentrations of 15.16 $\mu g\ L^{-1}$ in their blood. Skin-lightening products are extremely popular among the Indian and African population, as well as US, where, inter alia, Nephrotic Syndrome has been reported.

Cadmium can be present in inorganic pigments found in cosmetic products. It has been shown that cadmium can concentrate in bones, kidneys and teeth. Studies conducted on rats indicate that contact with cadmium results in fetal growth inhibition and teratogenicity. Cadmium concentration in lipsticks was at the level of 0.07 mg $kg^{-1}$ in samples from China and 0.01 mg $kg^{-1}$ in samples from Europe . The FDA has not yet defined the maximum cadmium concentration in cosmetics. However, Regulation (EC) No 1223/2009 prohibits the use of cadmium and its compounds in the cosmetics. The IARC (International Agency of Research on Cancer) classified cadmium and lead as group 2A of carcinogenic substances. Cosmetic products, especially lipsticks, can be dangerous to health, as average women inadvertently swallow as many as 4 pounds of lipstick during their lifetime. Cadmium can also be found in rinse-off products. Long-term use of these products may lead to skin rashes, epithelium problems, and distortion of other organs. Generally, toxic metals present in cosmetics may act directly on the skin or indirectly by absorption through the skin into the blood, leading to bioaccumulation and toxic effects in various organs.

**Impact on the Environment**

Heavy metals are well known toxic pollutants in the environment, its presence in the atmosphere can lead to accumulation of these metals in human body by bio accumulation. Most metals are naturally present in the earth and few are extracted from anthropogenic sources, most heavy metals contaminate the environment and causes atmospheric pollution which is harmful to the human body, Heavy metals are more toxic when mixed with environmental elements such as air, water, soil and also some living organisms which are later exposed to the humans by the natural process of food chain.

- Cadmium is found in the atmosphere as a result of natural or manmade activities, its pollution of the aquatic environment occurs through absorption, industrial wastes, and surface runoff into sediments soil and sediments. Cadmium does not have any attributes that are helpful for plant growth and metabolic processes.
- Mercury may be found in the biosphere as a result of human activities, it has also become a widespread contaminant as its concentration is constantly increasing in the atmosphere. When this metal is in contact with aquatic sediments it becomes more toxic and forms methyl-mercury.
- Lead is a non biodegradable metal present in nature but relatively found in lower concentrations. Lead in air is increasing

continuously as a result of human activities such as mining, burning fossil fuels etc,.

- Chromium a cancerous element is also found in the environment.

**Toxicity of Heavy Metals**:

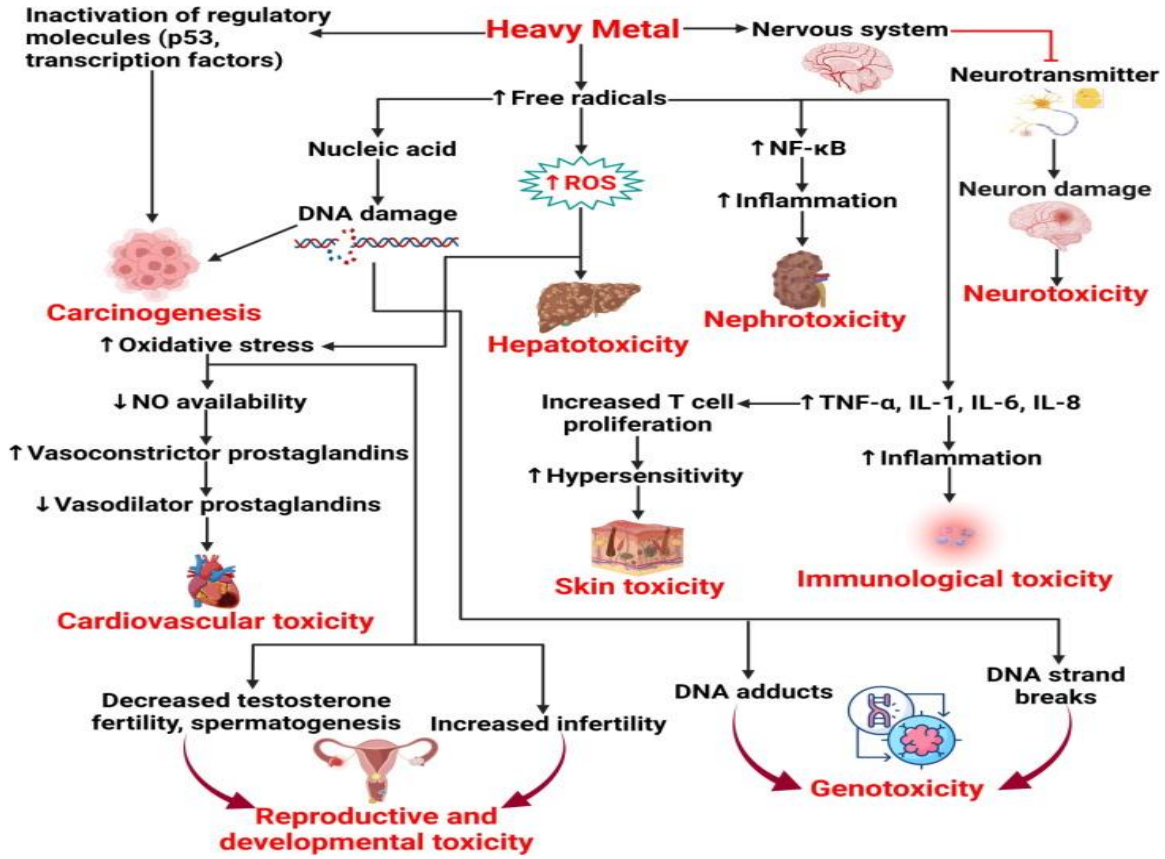



**Fig:** mechanism of heavy metal toxicity in humans.

1. **Neurotoxicity**: The central nervous system suffers from cognitive impairment when arsenic is consumed. It's also linked to a number of neurological illnesses, including neuro-developmental changes, and leads to excessive of neurodegenerative diseases. Many types of cellular activity, such as cell differentiation, proliferation, and cell death, are affected. The neurotoxicity of cadmium arise from neural cell death via apoptosis; providing plenty of apoptosis-induction factors, including impairment of neurogenesis, inhibition of neuron gene expression, offering epigenetic effect, endocrine disruption, etc.

Pathological investigations of poisoned animals and humans demonstrate that thallium toxicity causes damage to the brain and peripheral nerve. In addition to manganese, arsenic, and cadmium, a lot of heavy metals have been established for their neuro-toxic consequences. As well, copper and zinc, like iron, act as impediments to neurodevelopment when an excessive amount enters the brain.

2. **Nephrotoxicity**: Nephrotoxicity induced by cadmium leads to intense clinical symptoms such as glucosuria, Fanconi-like syndrome, phosphaturia, and aminoaciduria. Lead has deleterious effects in all organs, but it has the greatest influence on the kidneys. Acute lead nephropathy causes proximal tubular dysfunction, resulting in Fanconi-like syndrome. Chronic lead nephropathy can be characterized by hyperplasia, interstitial fibrosis, atrophy of the tubules, renal failure, and glomerulonephritis. Acute exposure of the kidneys to mercury causes acute tubular necrosis, and has many clinical symptoms, such as acute dyspnea, altered mental status, abdominal pain, profuse salivation, tremors, vomiting, chills, and hypotension. In contrast, chronic exposure to mercury causes injury to the epithelium and necrosis in the pars recta of the proximal tubule. Tubular failure, higher urine excretion of albumin and retinol-binding protein, and a nephritic state with a characteristic of membranous nephropathy are all symptoms of mercury-induced chronic kidney injury.
3. **Carcinogenicity**: Arsenic causes epigenetic alterations, damage to DNA, changes in the p53 protein's expression, histone modifications, DNA methylation, and reduced p21 expression, Arsenic poisoning raises the risk of cancer by attaching to DNA-binding proteins and slowing down the DNA-repair process.

Lead is a carcinogenic substance that causes damage to the DNA repair mechanism, cellular

tumor regulating genes, and chromosomal structure and sequence by releasing ROS hence it disrupts transcription by shifting zinc from certain regulatory proteins. Mercury's per oxidative activity generates a significant quantity of reactive oxygen species (ROS), which can aid pro-tumorigenic signaling and cancerous cells growth. ROS can contribute to carcinogenesis by damaging cellular proteins, lipids, and DNA, resulting in cell damage.

4. **Hepatotoxicity**: The toxicity of lead on liver cells is well established. Exposure to it increases oxidative stress resulting in liver damage. Organic solvents, combined with lead, also cause injury to the liver because of having the same characteristics as lead.

Copper is well known to accumulate in the liver due to Wilson's disease. Increased levels of copper may cause oxidative stress; therefore, hepatic copper deposition is not only pathognomonic, but also pathogenic. Elevated hepatic copper levels are also observed in cholestatic liver diseases. However, they result from diminished biliary excretion of copper and are not a cause of hepatic infection.

Numerous studies have shown that Cr (VI) can harm the liver, and histopathological changes such as steatosis of hepatocytes, parenchymatous degeneration and necrosis were already identified. Elevated ROS levels, lipid peroxidation, suppression of DNA, RNA, and protein synthesis, DNA damage, decrease of antioxidant enzyme activity, mitochondrial dysfunction, such as impaired mitochondrial bioenergetics, cell growth arrest, and apoptosis are all associated with Cr(VI) hepatotoxicity.

5. **Immunological toxicity**: Acute and chronic lead exposure leads to several toxic effects on the immune system and causes many immune responses, such as increased allergies, infectious diseases, and autoimmunity, as well as cancer.

Occupational and environmental exposure to cadmium may induce immunosuppressive effects based on varying exposure conditions. Humeral immune responses are amplified at low exposure, whereas the effects at higher exposures are not yet established. However, phagocytosis, natural killer cell activity, and host resistance in experimental infections are notably reduced in most cases. Chromium is known to have many adverse effects on the human immune system. The influence of chromium on the immune system has been explored in numerous experimental studies.

6. **Cardiovascular toxicity:** Lead exposure, either acute or chronic, produces a variety of abnormalities in the human body. Chronic exposure to lead may cause arteriosclerosis and hypertension, thrombosis, atherosclerosis, and cardiac disease by increasing OS, reducing NO availability, increasing vasoconstrictor prostaglandins, altering the renin–angiotensin system, lowering vasodilator prostaglandins, disrupting vascular smooth muscle Ca2+ signaling, increasing inflammation and endothelium-dependent vasorelaxation, and adjusting the vascular response to vasoactive agonists. Exposure for a long time also increases arterial pressure.

Cadmium is a toxicant and carcinogenic metal. In addition to its carcinogenic properties, cadmium induces kidney disease, bone disease, and cardiovascular disease.

7. **Skin toxicity:** Chronic arsenic exposure promotes a lot of possible skin diseases, including hyperkeratosis, hyperpigmentation, and several types of skin cancer. Hyperpigmentation is the most prevalent skin change caused by prolonged arsenic exposure. Arsenic exposure can potentially cause Bowen's disease, a type of early skin cancer. Arsenic hyperkeratosis is usually widespread, affecting the soles and palms, but it can also affect the legs, toes, fingers, arms, and dorsum of the hands. Some hyperkeratotic and Bowen's disease lesions have the potential to develop into invasive malignancies.
8. **Reproductive and developmental toxicity:** Several studies conducted by the World Health Organization (WHO) have found that more than 10% of women are at risk of infertility because of their exposure to heavy metals such as lead, cadmium, mercury, and other pollutants, which are the most common environmental contaminants that can cause reproductive disorders. The risk of infertility in women elevated as a result of increasing levels of toxin exposure, which resulted in hormonal disruption, delayed ovulation, and chromosomal abnormality in oocytes. Female infertility is caused mostly by hormonal imbalance, which is exacerbated by endocrine disruption caused by heavy metal poisoning, which is the most common cause of female infertility currently.

**Conclusion:**

Heavy metal toxicity is the contamination of environment via various heavy metal toxins such as Cadmium, Arsenic, Chromium, lead, etc. which are characterized by high atomic masses and toxic nature. These metals are found naturally in the environment and are easily available in the surroundings affecting the living organisms surrounded by it. It causes a lot of harm to the human health even death depending on various things like amount of time exposed to the heavy metal, type of heavy metal exposed and many more things, nervous system, digestive system, hepatic system and more vital organ systems are affected by this. Heavy metals are elements found in nature that accumulate in the environment mostly due to anthropogenic activities. Humans are exposed to

them by occupational exposure or consuming foods that contain these elements. These substances can cause toxic effects that affect health and well-being.

This activity outlines the evaluation and management of heavy metal toxicity and highlights the role of the inter-professional team in improving care for this condition in individual patients and communities at large. The toxic effects of these metals, even though they do not have any biological role, remain present in some or the other form harmful for the human body and its proper functioning. They sometimes act as a pseudo element of the body while at certain times they may even interfere with metabolic processes. Few metals, such as Aluminum, can be removed through elimination activities, while some metals get accumulated in the body and food chain, exhibiting a chronic nature. Various public health measures have been undertaken to control, prevent and treat metal toxicity occurring at various levels, such as occupational exposure, accidents and environmental factors. Metal toxicity depends upon the absorbed dose, the route of exposure and duration of exposure, i.e. acute or chronic.

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