

Mercury Poisoning and its Analytical Aspects: A Review

Jyothisha Katta¹, Sneha Yadav², Anuwanshi³, Anita Yadav⁴

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Abstract

Heavy metal poisoning is becoming more and more prevalent in current scenario. Among those heavy metals mercury toxicity is mostly reported. Natural and anthropogenic sources were releasing the mercury into the atmosphere and getting deposited in the air, land and on water and causes severe air and water pollution. Mercury exists in three forms, elemental, inorganic and organic form. All the three forms of mercury are toxic in nature. Mercury is used in dental amalgams, thermometers, barometers, vaccines, skin creams, blood pressure monitors, batteries and in other products. Mercury enters into the body through inhalation, ingestion and through the dermal contact. The severity of the mercury poisoning depends upon the route of exposure, quantity of dose intake, and the time period of exposure. If the living organisms exposed for longer duration chronic poisoning occurs. Elimination of mercury from the body occurs through sweat, tears, urine, faeces, and through breast milk. Bio conjugated gold particles, atomic fluorescence spectrometry, mass spectrometry, cold vapor atomic absorption spectroscopy and miscellaneous methods were used for the detection of mercury. Consumption of sea food and exposing to the products containing mercury causes severe health impacts. Methyl mercury is more toxic in nature it causes severe neurological damage to the infants. This review addresses about how mercury is deposited in the different organ systems and changes occurred in the different organ systems due to mercury poisoning. Mercury causes severe cellular, cardiovascular, neurological, immunological, digestive, renal, endocrine, reproductive and embryonic toxic effects.

Keywords: Elemental mercury; Inorganic mercury; organic mercury; Toxicokinetics; Toxicity.

Author's Affiliation: ¹Student, Department of Forensic Science, ^{2,4}Assistant Professor, ³Ph.D. Scholar, Division of Forensic Science, School of Basic and Applied Sciences, Galgotias University, Greater Noida-201312, Uttar Pradesh, India.

Correspondence: Anita Yadav, Assistant Professor, Division of Forensic Science, School of Basic and Applied Sciences, Galgotias University, Greater Noida-201312, Uttar Pradesh, India.

E-mail: anitakakas7@gmail.com

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INTRODUCTION

Mercury is a heavy metal. It is one of the most dangerous global pollutants.¹⁷ Mercury naturally occurs from the earth's crust.⁴ Mercury is available in the environment in three forms, elemental, inorganic and organic form. Elemental mercury which is of poisonous as a vapour⁸ and is available in liquid form at the room temperature, and due to its high vapour pressure, it was

released into the atmosphere in the form of a mercury vapour.²⁵ Inorganic mercury exists in two oxidation states, one is of mercurous Hg⁺ and the other is of mercuric Hg²⁺. Both are available in solid state as mercuric or mercurous salts and compounds of mercury with oxygen, chlorine and sulphur. Methylmercury and ethyl mercury where the common forms of organic mercury which are combined with the carbon. Formation of methyl mercury also occurs due to the methylation of inorganic mercury by the microorganisms in the environment.²⁵

All the three forms of mercury are toxic in nature and also causes various health effects.¹⁸ Due to the ample availability of numerous chemicals the intoxication rate had been increasing rapidly. People may either misuse the drugs and the chemicals and might get poisoned either intentionally or by accidentally, like wise heavy metals which are released either from the natural sources or from the industrial waste poses a severe threat to the human being and animals. Mercury enters into the human body through various routes. Inorganic mercury enters into the body through ingestion and through the absorption by skin. The elemental mercury enters into the body through inhalation in the form of vapour.²

The level of toxicity differs from different form of mercury and also varies with the amount of dose taken.¹⁶ The main target organ for the inhaled mercury is of brain, mercurous and mercuric salts acts on kidney, and the methyl mercury is distributed whole over the body.³ Methyl mercury is more toxic and causes severe neurological damage.²⁷ Living organisms will expose to mercury through drinking water also.²⁸ Elimination of mercuric mercury mainly occurs through the urine and stool and some amount of mercury is eliminated through the sweat, tears, saliva and breast milk.³

HISTORY

Minamata disease: Occurrence of large scale food poisoning due to methyl mercury was discovered in Minamata, Japan. This disease occurred due to the consumption of sea food contaminated by the release of sewage from the local chemical factory present in a Minamata city. There are abundant number of toxins present in the effluents released from the factory with the methyl mercury which is responsible for poisoning. Severe neurological symptoms occurred in 1950s and the disease was identified in the year 1956. Until 1968 the factory

doesn't cease the discharge of the toxic effluents and eventually in that year the Japan government officially confessed a causal relationship between the neurological disorders and waste water from the factory. The patients affected with that disorder has shown many neurological signs as well as paraesthesia, dysarthria, ataxia, visual field constriction, difficulties in hearing and psychiatric symptoms. Not only the residents in Minamata were affected but also the other neighbouring communities near the shiranui sea were also affected.²¹

SOURCES OF MERCURY

Both the natural and the anthropogenic sources were releasing the mercury into the atmosphere. The main natural sources of mercury deposition occur from the volcanic eruptions, weathering of rocks, burning of forests, and by the evaporation of water and from the soil.¹⁷ Degradation of minerals also release the mercury into the air. Burning of the fossil fuels, mining of the metals, and the industrial activities like processing of ore, production of cement, combustion of coal, coal firing plants, the production of gold, breaking of fluorescent lamps, auto head lamps, thermostats, manometers, thermometers, dental amalgams, were the main anthropogenic sources of the mercury contamination.²⁷ Human exposure mainly occurs through the inhalation of the elemental mercury vapours through the occupational exposure or through the dental exposure.²² Consumption of sea food is also one of the major sources of human exposure.¹⁶ Intake of topical antiseptics and vaccines are also one of the major sources of mercury exposure.¹⁶

CYCLING OF MERCURY IN THE ATMOSPHERE

Mercury and the compounds related to the mercury will be concentrated in the soil and then it will spread into the air through mining of coal fuels, industrial furnaces and through the active volcanoes.¹⁸ The mercury vapour rises from the land and sea surfaces. Most of the atmospheric mercury is present in the elemental mercury vapor form which is a chemically stable monatomic gas and this gas will be circulated in the atmosphere up to 1 year. This mercury vapour widely spreads in the atmosphere and can travel up to thousands of miles from the actual point of the emission. Mercury vapor gets oxidized in the top most layer of the atmosphere and gets converted into water

soluble ionic mercury and returns back to the surface of earth in the form of rain water. Rain water containing mercury will be deposited in

the land and in oceans.²⁷ Certain micro-organisms present inside the water will convert the mercury into methyl mercury which is highly toxic in nature

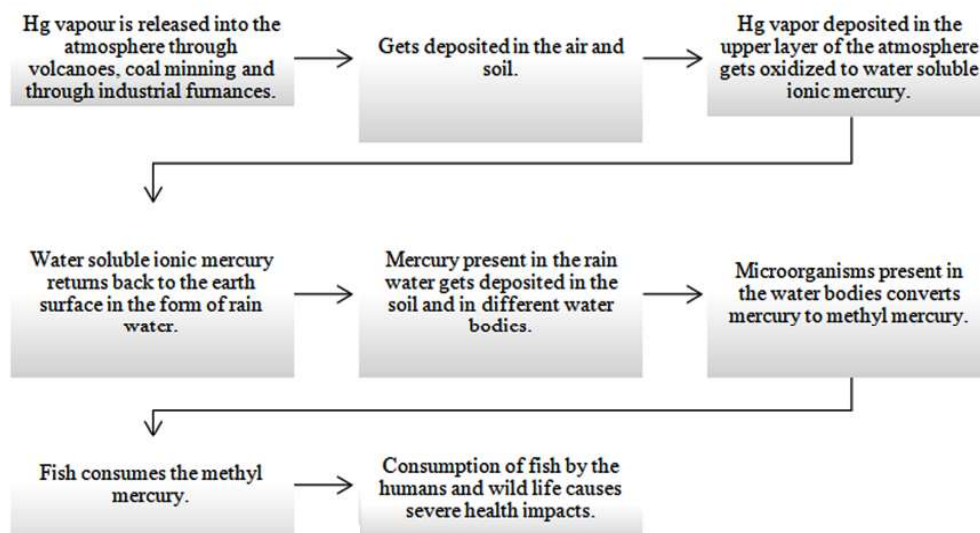


Fig. 1: Cyclic distribution of mercury in the atmosphere.

that spreads into the fish and shell fish and that too on the humans and animals that consume fish⁴

TYPES OF MERCURY

Elemental mercury

It is also called as quick silver.¹ The relative vapour pressure of elemental mercury is 0.261pa. Elemental mercury exists as a liquid in the room temperature and quickly turns into vapour when it is heated above the room temperature.¹⁴ It is used in thermometers, fluorescent light bulbs, mining and also used for some industrial purposes.¹ The exposure of elemental mercury occurs through the laboratories, work places and as well in homes. The mercury exposure in the home occurs through the broken thermometers containing mercury. Work place exposure occurs in industries like chlorine alkali manufacture, dental amalgams, electronic switches and fluorescent lamp manufacturing.¹⁴

Inorganic mercury

Metallic mercury is oxidized in the air and converts into inorganic mercury and releases into the atmosphere during rain and gets deposited in the soil and water.¹⁴ Inorganic mercury compounds combine with the other elements like sulphur and the oxygen to form ionic compounds.¹ They are widely used in medical purposes, cosmetics, antiseptics, teething powders, skin brightening

creams. Accidental poisoning is seen.¹⁴

Organic mercury

The inorganic mercury is readily converted into organic mercury.¹⁴ When carbon combines with the mercury assembling of organic mercury occurs. Methyl mercury is an organic compound of mercury which is naturally produced in the aquatic environment by methylation of inorganic mercury into organic mercury by the aquatic micro-organisms under normal potential of the hydrogen and the temperature conditions.¹ They are mainly used as a preservative in medicine. Exposure occurs through the medicines.¹⁴

TOXICOKINETICS OF MERCURY COMPOUNDS

Elemental mercury

Elemental mercury enters into the body through inhalation. Once inhaled it readily enter into the lungs and into the blood and gets easily distributed in the body.¹⁴ Elemental mercury diffuses easily and is of lipid soluble. It can easily cross the blood brain barrier, blood placenta barrier, lipid bilayers, cellular and intracellular membranes.²⁵ The main target of elemental mercury is brain and central nervous system. Elemental mercury is deposited in the kidneys, testes, pancreas, myocardium, skeletal muscles, myocardium and other organs and causes

systemic dysfunction.⁵ Metallic mercury is excreted as mercuric mercury.²²

Inorganic mercury

Inorganic mercury enters into the human body through the ingestion. After ingestion the mercury compounds will be deposited in the gastro intestinal tract. Absorption of mercury through the skin transport the mercury from the epidermis to sweat glands, sebaceous glands and to hair follicles. Mercury compounds are usually non-volatile solids. Highest concentration of inorganic mercury is deposited in the kidney. The main target of mercuric mercury is proximal tubule. Inorganic mercury salts do not easily cross the blood barrier because those salts are not lipid soluble. They are mainly excreted through urine and faeces.²⁵

Organic mercury

Mercury in the elemental and inorganic form is altered into the organic form.⁵ Methyl mercury is one of the organic compounds. Methyl mercury absorbed through skin readily enters into the blood stream and binds to the sulfhydryl groups. Methyl mercury is distributed to the peripheral tissues through one more transporter, especially through the cysteine transporter, and the cysteine transporter binds to the sulfhydryl groups in the cysteine. Methyl mercury concentrates easily in the liver, brain, kidneys, placenta, and foetus. Deposition of methyl mercury in the certain organs slowly undergoes demethylation process and converts into inorganic mercury. Methyl mercury is excreted through breast milk²², bile and through faeces.²⁴

TOXICITY OF MERCURY

Elemental mercury

Acute inhalation at high concentration causes respiratory distress, dyspnea¹⁴, dermatitis, subcutaneous granular formation, lung damage, death due to hypoxia.²⁵

Chronic exposure impairs the functions of the central nervous system, causes tremors, memory loss, delusions, neurocognitive disorders¹⁴, erethism, gingivitis, stomatitis, depression, nephrotic syndrome and proteinuria.²⁵

Inorganic mercury

Acute poisoning occurs through the oral exposure. Acute dose of mercuric salts causes pain

in the chest with burning sensation, change in the colour of the oral mucosal membrane, damage of gastro intestinal tract, impaired kidney functions, dermatitis, discolouration of the nails, and corrosion of mucosal membrane occurs.¹⁴

Chronic exposure is rare, if in-case occurs it causes pink disease with symptoms extreme sweating, painful sensitivity of touch, fatigue, anorexia, irritability, apathy, photophobia and photophobia and polydipsia.¹⁴

Organic mercury

Methyl mercury causes neuro toxic effects like lipid peroxidation, mitochondrial dysfunction. Reproductive effects, carcinogenic effects like chronic kidney failure, adenoma, carcinoma and kidney cancer. Cardiovascular effects like blood coagulation, sclerosis of the arteries and the increase of blood pressure.²⁴ Visual field constriction, ataxia, dysarthria. Tumours, hearing loss somato sensory and nerve disorder occurs.¹²

IMPACTS OF MERCURY ON HEALTH AND ENVIRONMENT

Mercury causes various impacts on the environment and on human health.

Impacts on environment

Emission of mercury in the air occurs through gaseous elemental form. It can be easily transported into the air and can travel to far away directions from the emission source and the remaining are in the form of inorganic ionic mercury form and they will bind to the emitted particles. Because of their shorter life span in the atmosphere, they will be deposited on the land and the water bodies with 100-1000 kilometres from their actual source. Ocean currents transports a wide range of mercury.¹⁴

Air pollution

Elemental mercury is a liquid at room temperature and that can be evaporated easily into the environment. Small amount of mercury released into the small enclosed space can increase the concentration mercury levels in the air and inhalation of air containing mercury vapours is harmful to the health. Clothes, furniture, carpet and other porous items absorb the mercury vapours from the air and once after absorption they can't be removed easily. Thermostats, glass thermometers, barometers, and the switches in large appliances also release some amount of mercury into air.¹⁴

Water pollution

It occurs when the unwanted material is added in excess amount in the water. The contamination can occur through pesticides, from domestic, industrial mining and through other man made activities. Presence of mercury in the water can causes harmful effects to the humans, fishes and other sea animals.¹⁴

Impacts on health

Inhalation of mercuric vapours from the air, ingestion of drinking water, fish, vaccines, occupational exposures, and home exposure through batteries, thermostats, and through the skin lightening creams mercury is entering into the human body and causing serious health hazards on different parts of the body.²⁸ Elemental mercury can be easily inhaled and ingested through unintentional exposure or through mis-handling.⁹ Mercury is toxic in nature and it is unessential in the human body. Each form of a mercury has individual toxicological profile. People will expose to methyl mercury by the consumption of sea food, inorganic exposure occurs from food and mercury vapours from dental amalgam restorations.²⁵ The severity of the mercury poisoning depends upon the type of mercury, mode and the time period of exposure.⁸ Acute and chronic mercury poisoning occurs mainly due to the occupational exposure and the symptoms of chronic mercury poisoning can't be recognized easily due to the response of different organs and the tissues to the mercury and the signs of this chronic poisoning are not specific and that can lead to misdiagnosis.⁴ Mercury is one of the most dangerous pollutants in the environment which will never be destroyed and produces toxic effects.²⁵ Mercury causes toxic effects in the mammals and also effects the biological functions in the wildlife.⁶

Effects of mercury on cellular functions

Changes in the membrane permeability and in the macromolecular structure due to sulfhydryl and thiol group affinity, damage of DNA, reduction of oxidative stress and mitochondrial dysfunction, alteration of homeostasis in calcium and increase of lipid peroxidation occurs.¹⁹ Altered function of platelets and erythrocytes, decrease of phagocytic activity due to the apoptosis in monocytes is seen.²⁹

Cardiovascular, haematological and pulmonary effects

Mercury accumulation in the heart causes

cardiomyopathy. Mercury poisoning causes chest pain, anaemia, leukaemia. Inhalation of mercuric vapours enter into the respiratory system and then enter into the circulation and causes tremors, sleep disturbances, and also impair the cognitive skills in the workers. Mercury also causes several pulmonary disorders like young's syndrome, bronchitis and pulmonary fibrosis.¹⁹ Alteration of endothelial function of heart occurs.²³

Effects on digestive system

Mercury absorbed through the epithelial cells through the ingestion process causes various disturbances in the digestive system and inhibits the production of digestive trypsin, chymotrypsin, pepsin along with xanthine oxidase and dipeptidyl peptidase. Abdominal pain, indigestion, inflammation, bowel disease, ulcers and diarrhoea occurs.¹⁹

Effects on renal system

It causes severe damage to the kidney. Effects include tubular necrosis, glomerulo nephritis, chronic renal disease, renal cancer, nephrotic syndrome, tubular dysfunction, glomerulosclerosis, nephrotic syndrome, nephrotic range proteinuria occurs.¹⁹

Effects on immune system

Mercury supresses the production of adrenocorticosteroids and effect the function of PMN by inhibiting the ability to destroy the foreign substances and causes allergy, asthma, auto immune diseases, arthritis, thyroiditis, hyperactivity disorder, eczema, epilepsy, psoriasis, multiple sclerosis, rheumatoid arthritis, schizophrenia and scleroderma.¹⁹

Effects on nervous system

Mercury is accumulated in all the nervous tissues throughout the body. Mercury alters the cellular detoxification process and leads to the death of the cells. Mercury causes neuronal problems by blocking the P-50 enzymatic process. Mercury causes the oxidative damage of the tissues. Mercury damages the blood brain barrier in the central nervous system and facilitates the penetration of brain with the other toxic compounds. The effects in the central nervous system due to the mercury poisoning includes depression, paranoia, extreme irritability, hallucinations, unable to concentrate, memory loss, tremors on the hands, lips, tongue, jaws and eyelids, loss of weight, low body temperature, headache, insomnia, fatigue.¹⁹, changes in the behaviour,

dysarthria, incoordination, and death occurs.²³ Effects on the special sensory systems include blindness, hearing problems, reduced sense of smell, abnormal sensations of touch.¹⁹ Alzheimer's disease, Parkinson's disease, Amyotrophic lateral sclerosis, multiple sclerosis is seen.⁷

Effects on endocrine system

Low level of exposure levels of mercury in the animals and humans effects the endocrine system by disrupting the pituitary, adrenal glands, thyroid and pancreas. Diabetes, hypothyroidism, thyroid inflammation, and depression is seen.¹⁹

Effects on reproductive system

Mercury affects the reproductive system by altering the functions of hypothalamus, pituitary, adrenal and gonadal axis. The function of the reproductive system gets altered by altering the circulating levels of follicle stimulating hormone, luteinizing hormone, inhibin, estrogen, progesterone, and through androgen. Reduced fertility rate is seen in the dental assistants through occupational exposure. Infertility in both men and women, adverse effects on spermatogenesis, epididymal sperm count, and testicular weight in men. Changes in the estrogen and the progesterone level, ovarian dysfunctions, painful and irregular menstruations, premature menopause, tripped uterus, and abnormal bleeding are seen in females.¹⁹

Fetotoxicity

Mercury causes fetotoxicity and causes miscarriages, abortions, still birth and low birth weights. Mercury exposure during the pregnancy causes neural tube defects, craniofacial malformations, and delayed growth. Babies may be born with variety of birth defects.¹⁹ Consumption of sea food contaminated with the methyl mercury during the pregnancy brings changes in the blood vessels and in heart.³ Neurological abnormalities, delayed onset of walking and talking, cerebralpalsy, deep tendon reflexes, altered muscle tone were seen in the infants born to the mother who were exposed to methyl mercury during pregnancy.²⁷

DIAGNOSIS

The body absorbs the mercury and gets deposited in the certain tissues like hair, blood, fingernails and then it will start distributing to different parts of the body through blood. Each and every organ of the body should be examined in order to know

the whole concentration of mercury deposited in the body.¹⁶

Concentration of mercury in blood

Concentration of blood in the mercury increases very rapidly on exposure of any form of mercury. In order to get the authenticated results, the measurements should be taken only after the exposure. If the people were exposed to a mercury for long time and even if they stopped exposing to mercury still their concentration levels are very high because of already accumulation of mercury in the body. The more concentration of mercury in the blood is due to methyl mercury. In the blood the concentration of mercury is usually below 10-20 microgram/litre. When people expose to inorganic mercury for the longer period then the concentration of mercury in the blood may rise up to 35 microgram/litre.¹⁶

Concentration of mercury in urine

Due to the characteristic medium the concentration of mercury in the urine is very stable. It is the easiest way to analyse the mercury exposure. The analysis of metallic and inorganic mercury through urine is very easy when compared to organic mercury. The persons who were exposed to mercury for a long time, due to the burden in the body those persons will excrete a small amount of mercury through the urine. When the mercury level in the urine is increased upto 100 microgram/litre then the damage of central nervous system will occur.¹⁶

Concentration of mercury in the hair

80-90% of the hair consists of keratin and the keratin consists of sulfhydryl groups. The mercury binds to the sulfhydryl groups and gets deposited in the hair. The concentration of mercury in the hair is more if the person exposed to the mercury for longer periods. The normal amount of mercury in the hair is about 10 milligram/kilogram. In case of acute poisoning, it is 200-800 milligram/kilogram. 2400 milligram/kilogram concentration in the hair is very toxic.¹⁶

METHODS FOR THE DETECTION OF MERCURY

Bio conjugated gold particles

A change to the surface of gold nanoparticles called a bio-conjugate makes them more sensitive

and selective to certain interactions. Numerous studies were conducted to increase the efficiency of AuNPs because gold nanoparticles can be conjugated with a variety of biomolecules, including DNA, protein, and enzyme. Gold nanoparticles can be conjugated and functionalized in three different ways. The most popular method is to ligate molecules onto the surface of gold-nanoparticles by covalently linking gold and thiol groups. Electrostatic or hydrophobic interactions are also exploited in physical absorption. However, because this connection is weak, ligand molecules may separate in response to changes in pH or temperature in the AuNPs solution. The third method involves tagging gold nanoparticles with antigen and using them to detect antibodies while applying an explicit specificity of ligand molecules. This method is a vital concept for creating a platform to find any antibody and is frequently applied in the medical industry. A biosensor that can detect the mercury ions. Alkanethiols' sulphur group was employed to create a strong bond with gold nanoparticles, while the OH functional group was used to draw in mercury ions.¹¹

Atomic fluorescence spectrometry

Flame atomization was mostly used in earlier work. Mercury's aqueous solution limit of detection, as determined by Flame atomic fluorescence spectrometry, it uses mercury at a 2ppb concentration. Utilizing an electrothermal atomization or a cold vapour atomization allowed for the further development of atomic fluorescence spectrometry.

Due to oxygen and nitrogen quenching, the fluorescence intensity in the air is decreased. Higher sensitivity is obtained when Ar is used in place of air (up to 86-fold). This is accomplished using either phase separation using porous polytetrafluoroethylene tubing or gold amalgamation. Using porous polytetrafluoroethylene tubing for phase separation or gold amalgamation, respectively. Picogram quantities of Hg in air and water may be determined using atomic fluorescence spectrometry.³⁰

Mass spectrometry

Despite its limited use, spark source mass spectrometry is used to determine the presence of mercury. The approach for detecting mercury in apples was employed in early research. However, the procedure can be extremely accurate by employing a stable isotope as an internal standard. It determines the total mercury content of biological

and botanical materials using isotope dilution spark source mass spectrometry.

Inductively coupled plasma mass spectrometry, coupled with a continuous reduction system using NaBH₄ will be applied to the micro-determination of mercury in natural waters and a reference sediment. Spark source MS, one of the most sensitive detection methods in the 1970s, is being replaced with ICP-MS.³⁰

Cold Vapor Atomic Absorption Spectrometry

In order to transform the various forms of mercury into its ions for the CV-AAS procedure, the samples were first digested and oxidised. Then, using 10% SnCl₂ · 2H₂O in 1% HCl, these mercury ions were reduced to the elemental form and aerated from a solution in a closed system. The concentration of mercury is determined by measuring the absorbance after the mercury vapour has passed through a cell. By using precise and appropriate sample collecting techniques, very low quantities of mercury can be found using the CV-AFS method. The sample is collected using a gold trap after undergoing oxidation and reduction into elemental form in the sample container. The fluorescence detector in a cell that measures absorbance which is passed through mercury vapours created during the desorption process.²⁰

Miscellaneous method

The detection of Hg with bioluminescence has been described as being very sensitive. Plasmid pGL4, which includes a Kanamycin resistance gene, the lux gene complex from *Vibrio hoveyi*, and the Hg regulator from plasmid pDG106, was used to convert microorganisms. The smallest detection threshold is ppb and the plasmid was Hg-specific even when other heavy metals were present. For the measurement of 80-300 mg cm⁻³ Hg (n), horse liver alcohol dehydrogenase activity was inhibited. Based on the oxidation of 3,3',5,5'-tetramethylbenzidine or o-phenylenediamine by H₂O₂ and horseradish peroxidase, an enzyme based approach for the measurement of Hg in natural waters was developed.³⁰

APPLICATIONS OF MERCURY

Mercury had been used in various metallic instruments like thermometers, blood pressure monitors, sphygmomanometers, barometers and also in the electrical appliances like lighting equipment

and dry batteries. More amount of metallic mercury is still in usage in other countries as a catalyst for the production of caustic soda by the electrolysis process. Mercury was also used in the various chemicals like mercurochrome, agricultural chemicals and mild dew proofing agents.¹³ Mercury was most frequently used in the class laboratories.⁸ Mercury is used as a preservative in vaccines¹⁵, preparation of red tattoo dye.²⁸

POST MORTEM FINDINGS

Acute Poisoning

The body looks very thin and feeble, Inflammation in mucosa, greyish colouration and congestion is seen in the gastro intestinal tract, ulceration is seen in the large intestine, glomerular degeneration in the kidney, acute proximal tubular damage, congestion and fatty changes in the liver, degeneration of fat and sub endocardial haemorrhage is seen in the heart.¹⁰

Chronic Poisoning

Body looks emaciated with the pale skin, oral mucosa erosion, bluish grey lines of pigment deposition in the gum of lower jaw, loosening of teeth, cerebral infarctions, pneumonia, renal cortical necrosis and disseminated intravascular coagulopathy is seen.¹⁰

CONCLUSION

All the three forms of mercury is toxic in nature. Mercury impacts not only the environment but also effects the health of the humans, wild life and also the health of an aquatic organisms. Mercury enters into the human body through various routes. Elimination from the human body occurs through the body fluids. Eating of sea food contaminated with mercury, inhalation of mercury vapours in the work places, exposure through skin creams, dental amalgams, vaccines, thermometers and through the other sources, it was entering in to the body and gets settled down in different organ systems causes severe cellular, cardiovascular, neurological, immunological, digestive, renal, endocrine, reproductive and embryonic toxic effects. Sea food contaminated with mercury should be avoided. Care should be taken by the people who are working in the metal mining areas. Make sure not to inhale the mercury vapours. Skin creams containing the mercury should be avoided. Disposing of industrial mercury waste into the

water reservoirs should be controlled. Mercury permissible limit in drinking water is 0.002 Mg/L (BIS specification).³¹ This limit should be followed while discarding the mercury into river water.

CASE REPORT

A 36-year-old lady who had been experiencing stomach pain, diarrhea, and fever for three days came to the emergency department. Her daughter had brought mercury in liquid form from the school one week prior without getting her teacher's permission. She had manipulated the mercury before placing it on the hot stove to see it vaporize. Her mother was also nursing her 14 month old sibling at the time. Without a clear diagnosis, her kid developed a fever 24 hours after the incident and passed away before being taken to the hospital. The autopsy report revealed possible mercury toxicity, which may have caused the infant's cardiorespiratory collapse and eventual death. Her temperature was 40.2°C, she had a consistent heartbeat of 105 beats per minute, she was breathing at 18 beats per minute, and a pulse oximeter at room temperature showed that her oxygen saturation was 96%. The patient had no history of illness. Her fever subsided after receiving 1 gram of paracetamol intravenously, and with the help of supplementary oxygen, arterial oxygen saturation increased to 98%. Her head-neck, respiratory, cardiovascular, and abdominal exams revealed nothing unusual. No signs of tremor, paresthesia, ataxia, spasticity, hearing loss or vision loss were seen during the neurological evaluation. There were no signs of aberrant neuropsychiatric behavior. Aspartate aminotransferase (AST), alanine aminotransferase (ALT), creatinine, complete blood count, urine, salt, potassium, blood urea nitrogen (BUN), and bilirubin levels were all within normal ranges.

No signs of disease were found on the cerebral computed tomography or chest X-ray. Because it was not possible to test for serine or urinary mercury levels in the city, symptomatic chelation therapy using N-acetyl cysteine (NAC) was started based on the patient's presumed diagnosis and medical history. She was released on the seventh day after admission without any complications or complaints. The mercury levels in the blood were measured the same day and were found to be 30 g/dL (the normal range, according to the hospital laboratory reference, is 0 to 10 g/dL). Her symptoms dictated the treatment, and it took three days for the official report of her laboratory findings. The patient returned to the ED a week after being

discharged because of persistent stomach pain.

She was released following a 24 hour observation period due to an unremarkable physical examination and laboratory test findings. A follow-up appointment was set for a week later. The patient was asymptomatic and there were no clinical findings during the follow-up appointment. NAC therapy was thus stopped after 14 days of therapy. The sickness did not manifest in any way in the other kids.

Pneumonia, adult respiratory distress syndrome, progressive lung fibrosis, and even death, can all result from acute inhalations of mercury vapors. Additionally, elemental (metallic) mercury can easily enter the bloodstream through the skin or alveoli found in mercury vapor. Furthermore, it has been proven that nursing moms' breast milk can directly transmit to infants. The prevalence of gastrointestinal symptoms and history results point to elemental mercury toxicity in the current instance.²⁶

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