



FACTS OF MERCURY TOXICITY: A REVIEW

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ABSTRACT

Mercury is a highly potent cell toxin with various effects on human and animal nervous systems. Exposure to mercury can happen by various sources, of which dental amalgam filing is the one of the most common and prevalent source. Dental amalgam is a mixture of mercury and silver alloy powder that solidifies at mouth temperature. It is a non-degradable environmental pollutant. Mercury has many toxic effects on the body systems, including most commonly effect on nervous system. This article provides an overview of various facts of

mercury toxicity to create awareness about the safe handling and proper waste disposal of mercury.

KEYWORDS: Mercury, Waste disposal, Toxicity.

INTRODUCTION

Infection control programme of the health care office includes proper handling, treatment and disposal of biomedical wastes. Mercury is one of the most important and toxic biomedical waste, used in dental amalgam fillings. Mercury combines readily with other metals to form solid amalgams, which have been used commonly to reconstruct decayed teeth in dentistry,

since nearly 200 years. But the use of Mercury in dentistry has generated certain amount of controversies, since the middle of the 19th Century. This controversy has gained attention over the last 25 years, as various experimental sensitive analytical chemical techniques showed continuous release of mercury from dental amalgams. It is known from experimental animal studies that mercury vapors are continuously emitted from dental amalgam and are absorbed and accumulated in tissues and organs.^[1]

Although other filling materials are available for the preservation of decayed teeth, popularity of amalgam is maintained by its relative cheapness, durability, and ease of use.^[2] Mercury has also been used in other medical, chemical and electronic applications. It is very important that the dental practitioner understands the hazards and toxicity associated with the use of mercury, and controls exposures to prevent the development of any untoward effects.^[3]

Mercury and its forms

As early as in the 7th century, the Chinese used a “silver paste” containing mercury (Hg) to fill decayed teeth. In the middle Ages, alchemists in China and Europe observed that this mysterious silvery liquid, extracted from cinnabar ore, was volatile and would quickly disappear as vapor when mildly heated.^[4,5]

Purest form of mercury is the elemental mercury. Though it is liquid at room temperature, it evaporates into mercury vapor. Once in the atmosphere as a gas, ultimately it is redeposited on the earth with precipitation. When on the earth or in the waterways, it is incorporated into sludges or sediments, where it is methylated. Humans are exposed to methylmercury as they consume fish and shellfish.^[5,6]

• Various forms of mercury

- ❖ Organic mercury: The source of organic mercury for the general population is methylmercury from the consumption of fish and shellfish.^[6]
- ❖ Inorganic mercury: Inorganic mercury is in form of powder or crystals, it is ionic form of mercury which has been reacted with anions like sulfur or oxygen. Blood inorganic mercury concentrations have been used to detect acute, high dose exposures. Urinary mercury concentration is the preferred method for assessing inorganic mercury exposure in chronic low to moderate exposures.^[3,6,7]

- ❖ Mercury vapor: Exposure to mercury vapor is commonly associated with occupational exposures, accidental exposures, and also some bizarre “recreational” exposures have been identified.^[6]

Mercury in relation to dentistry

Amalgam fillings contains 50% Mercury, with the remainder principally Silver and small amounts of Copper, Tin or Zinc. Mercury from amalgam fillings primarily contributes to the daily absorption of mercury in two ways. Mercury is released in vapor form, inhaled, and up to 80% is reabsorbed in the airways. Abraded amalgam particles are swallowed and to a smaller extent oxidized in the intestinal tract. Less than 10% of such ingested mercury is reabsorbed as Hg⁺².^[2,3,7]

Mercury toxicity

Either ingested or inhaled, mercury is toxic to humans. Studies show that mercury vapor can damage the lungs, kidneys, digestive, respiratory, and immune systems. Mercury can also be taken up in the nerve ends and transported in a retrograde direction to ganglia and central nerve cells. Mercury vapor has also been linked to tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, and developmental deficits during fetal development.^[5] It has long been known that mercury is cytotoxic. The cytotoxic effect is exercised by Hg⁺². Mercury vapor, which is transported by the blood, can diffuse into the cell. Being relatively fat soluble, mercury vapor easily passes through cell membranes. Intracellularly, mercury is oxidized enzymatically to Hg²⁺. The mercury ion does not pass as easily through cell membranes but is bound in the first instance to the outside of the membrane. In some cases it can then be transported intracellularly actively, via receptors or bound to another transferable molecule.^[7]

The mercury ion binds to selenohydryl (SeH-) and sulphhydryl (SH-) groups. SH-groups constitute an important component in proteins. Mercury binding to these can entail a change in the proteins' tertiary and quaternary structure and other binding conditions in prosthetic groups in enzymes and block or modify receptor binding and potassium or calcium ion flows in the cell membrane's pores and ionic channels. This affects cell membrane potentials as well as intra- and inter-cellular signals.^[7]

Animal experimental, clinical and epidemiological observations have shown that during exposure to mercury vapor, which gives rise to plasma concentrations of mercury of between

0.1 and 1 $\mu\text{mol/l}$ (20 – 200 $\mu\text{g/l}$) or above, clinical signs of disturbances from several organ systems appear. The internal mercury burden is best reflected by its concentrations in blood and urine.^[4]

Symptoms can appear early on from the nervous system. These include neurological signs such as tremor, reduced colour vision, peripheral nerve conduction velocity, poorer performance in psychomotor tests and memory function, altered electrophysiological parameters (evoked response), psychological symptoms such as increased irritability and exhaustion; sleep problems, and an increased tendency to anxiety. In the event of long-term exposure to concentrations of mercury producing symptoms, dementia and permanent functional impairment appear.^[7]

Mercury Waste Management

- It is recommended that, train all personnel involved in the handling of mercury and dental amalgam regarding the potential hazards of mercury vapor and the necessity of observing good mercury hygiene practices.^[2]
- Professional clothing should be removed before leaving the work place.^[2]
- Should work in well ventilated areas, with fresh air exchanges and outside exhaust.^[2]
- Floor coverings should be non-absorbent, easy to clean and seamless.^[2]
- Periodical checkup of dental operatory atmosphere for mercury vapor should be done. This may be done through the use of mercury vapor analyzer and using dosimeter badges for rapid assessment after any mercury or clean up procedure.^[2]
- To control the vapor during intraoral procedure, a rubber dam can be used to isolate the patient and high-volume evacuation should be used to prevent intraoral vapor from diffusing.^[2]
- Safe depositories should be used to dispose of excess mercury. instead of recycling depending upon the facility and finance available.^[2]
- Scrap amalgam from condensation procedures should be collected and stored under water, glycerin, or spent x-ray fixer in a tightly capped jar and should be disposed properly.^[2]
- The ADA strongly recommends recycling as a best management practice for dental offices.^[2]

CONCLUSION

Regular control of working atmosphere and increased awareness about mercury hygiene should be implemented to prevent mercury exposure. It is recommended that dentists should use alternative dental materials in place of amalgam, whenever this is available and affordable. Finally, additional research is still needed to develop the methods for reduction of mercury waste generation and its proper disposal.

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