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Case Report

Parenteral Mercury Poisoning – An Interesting and Rare Case

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Trace Metal Analyzer,
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Abstract

Mercury is an element found in the earth's crust. Pure mercury is a liquid metal, sometimes referred to as quicksilver that volatilizes readily. It has traditionally been used to make products like thermometers, switches, and some light bulbs, BP machines and also used in dental amalgams. The case represented here is of a 15 years old boy, who injected mercury of an old broken BP machine in his left wrist after watching a famous English movie "Wolverine" which was deposited subcutaneously. Later he developed localized necrosis and non-healing ulcer. He was then referred to AIIMS for further treatment and to corresponding author for further opinion. 24-hours urine, blood and nail samples were collected and analysed further in departmental toxicological laboratory. The samples were digested on closed vessel microwave digestion and the digested clear transparent samples were then quantitatively estimated using trace metal analyzer. The results obtained were calculated according to the average value of blank reference sample and average value of standard of 1 ppm of mercury. After one week, again the samples were taken to check whether there is any increase or decrease in the level of mercury in the body. The analyzed samples showed an increase of 88µg/L in urine in one week duration however it was not present in blood and nails. The case report highlights importance of having well equipped toxicology lab which is of great help to clinical settings in giving clue or confirming the diagnosis.

1. Introduction

Mercury is a naturally occurring element mainly exist in three forms: Elemental or metallic, inorganic and organic mercury. Mercury is found in earth's crust in elemental form. Pure mercury is also known as quicksilver.

It has traditionally been used to make products like thermometers, BP machines, dental amalgams, as a preservative in medicines, some batteries and light bulbs.¹ The factors that determine how severe the health effects are

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from mercury exposure include: chemical form of mercury, the dose, age of the person exposed (fetus is the most susceptible), duration of exposure, route of exposure (inhalation, ingestion, dermal contact) and the health of the person exposed.² Elemental (metallic) mercury primarily causes health effects when it is breathed as a vapour where it can be absorbed through the lungs. These exposures can occur when elemental mercury is spilled or products that contain elemental mercury break and expose mercury to the air, particularly in warm or poorly-ventilated indoor spaces. Symptoms of mercury exposure include tremors, emotional changes like mood swings, irritability, nervousness, excessive shyness, insomnia, neuromuscular changes (such as weakness, muscle atrophy, twitching), headaches, disturbances in sensations.³

Acute exposure to elemental mercury and vapour can result in acrodynia or “pink disease”, which is characterized by bright pink peeling palms, fingers and soles of the feet, excessive perspiration, itching, rashes, joint pain and weakness, elevated blood pressure and heart palpitations.³ Mercury exposures in a particular population has been monitored by measuring mercury in blood, cord blood, hair, urine and breast milk. The presence of mercury in blood indicates recent or current exposure to mercury. Mercury level in hair is an indicator of long-term exposure. The presence of mercury in urine generally represents exposure to elemental mercury.²

2. Case History:

A 15-years old boy presented with symptoms of mercury exposure was referred to AIIMS, New Delhi by local hospital. An internal referral was sought from emergency medicine to corresponding author for further advice. Upon interaction with patient, it was found that the boy injected mercury of a broken BP machine on his left wrist using syringe to become superman/spiderman after getting inspiration from a famous Hollywood movie “Wolverine” (Fig. 1 - 4). On further psychological evaluation it was revealed by him that he had also tried to become Shaktiman (a fictitious Indian superhero) few years ago after watching the Famous TV serial Shaktiman on Doordharshan channel but he failed in his attempt. It was advised to collect two biological samples i.e., Blood- 2 ml & 24-hours urine and send to toxicology laboratory of the department for further analysis. Further it was also advised to

keep him admitted for one week and then repeat the tests. Again, same biological samples along with nails were collected and brought to toxicology laboratory, Dept of Forensic Medicine & Toxicology, AIIMS, New Delhi for further analysis.

Fig.1: Site of injection on left wrist and the non-healing ulcer



Fig.2: Effect of poisoning on left forearm - the ulcer and necrosed skin.



Fig.3: Effect of poisoning : bullous eruptions on tattoo.



Fig.4: Scar of previous surgery done for removal of subcutaneously accumulated mercury.



3. Material & Methods:

3.1. Reagents and their preparation:

3.1.1. Microwave Digestion (Fig. 5): The nitric acid used was 69% obtained from Merck (7.5 ml of Nitric acid and 7.5 ml of ultrapure water was mixed and used for digestion for per sample).

Fig. 5: Make - Aurora Instruments Ltd, Canada Model - MW 680 Microwave Digestor



Fig. 6: Make-Metrohm, Switzerland, Model – 797VA Trace Metal Analyzer (Application Bulletin 96/5e by Metrohm India Limited) ⁴

3.1.2 Trace Metal Analyzer (Fig. 6):

Primary Solution: a) NaCl – 0.175 gm b) EDTA – 0.75 gm c) HClO₄ – 9.4 ml. All reagents were mixed and made up to 500 ml with the help of ultrapure water.



Hg Standard: 1 ppm – 0.1 ml of mercury standard from 1000 ppm mercury standard and make up to 100 ml for 1ppm of Hg using $N1V1 = N2V2$ formula.

Reference blank sample/ Control sample: The biological samples from (blood, urine and nails) from an individual was taken without the history of Hg Poisoning were taken and digested and analyzed. All the reagents were from MERCK.

3.2 Digestion Procedure:

All the biological samples (Blood and 24 hours urine for the first time and after a week blood, 24 hours urine and nails for the second time) were collected and prepared for digestion in microwave digestion. (1 ml of blood and 5 ml of urine each) samples were mixed with 15 ml of 34.5 % HNO₃ then loaded in the carousel of microwave digestion oven and digested using the program on microwave digestion as shown in **table no. 1**. Both the control samples and suspected samples were digested using the same procedure. The samples were then cooled and outgassed in the fumehood and transferred into volumetric flask of 25 ml and make up 25 ml with the help of ultrapure water. The samples were then analysed by trace metal analyzer.

Table 1: Program for Digestion

Step	Time (sec)	Starting temp (°C)	Ending temp (°C)
1.	210	28	100
2.	600	100	160
3.	600	160	170

3.3 Analysis by Trace Metal Analyzer

Trace metal analyzer (TMA) of model no. 797 VA computrace of Metrohm company was used for qualitative as well as quantitative analysis. The samples were analysed using glassy carbon and gold electrode. First the cleaning procedure was done using 10 ml ultrapure water and 2 ml of primary solution. Then for sample analysis 10 ml of primary sample was taken in the vessel and the analysis was started.

The voltamogramme of the blank was recorded. 0.1 ml of the prepared sample solution was added to the polarographic vessel and then voltamogramme of the sample solution was recorded under the same conditions. Afterwards 0.1 ml of 1 ppm Hg standard was added twice and then voltamogramme of the standard was recorded. Finally the concentration of the metal was calculated by linear regression method using following formula:

$$\text{Final Results} = \text{Concentration X} \frac{\text{Cell Volume}}{\text{Sample amount}} \times \frac{\text{Multiplier}}{\text{Divisor}}$$

Where, Multiplier = dilution

Divisor = sample amount taken for preparation

The control samples, suspected samples and the standard samples were analysed using the same procedure.

4. Results:

The level of mercury in different biological samples after interpretation are shown in **table no 2**. The results showed an increase of 88 $\mu\text{g/L}$ in urine in one week duration suggesting slow elimination of Hg from the body since only urine gave positive results for elemental Hg poisoning (**Fig.7**). The values of mercury in the urine > the toxicity level given by OSHA. As per OSHA (Occupational Safety & Health Administration exposure) the reference values are given in **table no 3**.⁵

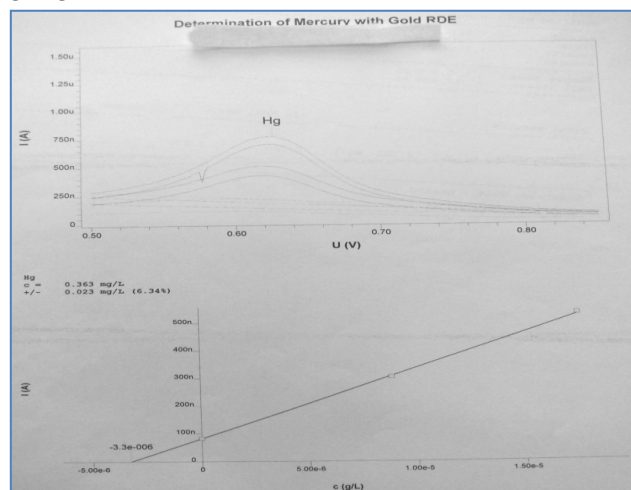
Table: 2: Quantity of mercury in biological samples

S.No	Duration	Blood	Urine	Nails
1.	1 st Day	Nil	139 $\mu\text{g/L}$	Nil
2.	7 th Day	Nil	227 $\mu\text{g/L}$	Nil

Table.3: Normal and Toxic levels of Mercury

Matrix	Normal Level	Toxic Level
Blood	<2 $\mu\text{g/L}$	>3 $\mu\text{g/L}$
Urine	<10 $\mu\text{g/L}$	>20 $\mu\text{g/L}$
Nails	<1 $\mu\text{g/g}$	>2 $\mu\text{g/g}$

Fig.7: Voltamogramme and Calibration curve of Hg in Urine.



5. Conclusions:

Mercury in sphygmomanometer is in elemental form and is non-toxic, unless it is heated or its vapours are inhaled and reached to lungs. If it is ingested, it will be excreted out through faeces. If it is injected, it forms subcutaneous embolism which happened in this case. Elemental mercury is excreted from the body in a very slow manner and it is mostly found in urine. The series of investigations which were performed helped in reaching the diagnosis so that chelation therapy can be started. For every case of poisoning there should be proper history taking, examination and investigations that should be carried out in meticulous manner.

Contributor ship of Author: All authors equally contributed.

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