The determination of total mercury in blood and urine samples collected from people worker in and living beside the Al-Furat Company for Industrial Chemistry- Saddat Al-Hindia/ Iraq

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Summery

Mercury toxicity can be predicted by the detection of elevated concentrations of mercury in blood and urine samples. A cross sectional study was conducted to evaluate the mercury levels in blood and urine samples of twenty five persons of workers from Al-Furat Company and people living beside. The persons enrolled were divided into five groups according to their potential mercury contact. All samples were digested and analyzed by Cold Vapor Atomic Absorption Spectrophotometer (CVAAS). Two factors were considered in the present study: age and duration of potential exposure to mercury. The results showed that the group one revealed higher mercury concentration in blood and urine (mean=0.05394 µg/ml, p-value ≥0.001 and mean= 247.6178, p-value ≥0.05respectivlly) in comparison with all other groups. Regarding the age, the people is divided into three age intervals, there is a positive correlation between age and mercury in blood, the age interval more than forty years revealed high mercury level in blood (mean=0.02691 µg/ml) in comparison with other two intervals, while the youngest people (less than thirty years), excrete higher mercury concentrations in urine (mean=127.702 µg/ml) than older. Moreover, the group of long period of exposure (more than twenty years) revealed an increased mercury levels in blood (mean=0.02958 µg/ml). However, there is diminishing in mercury concentrations in urine in the interval more than twenty years of exposure (16.7155 µg/ml).

Introduction:

The toxic effects of mercury have been observed for centuries. The phrase "mad as a hatter" was coined due to neurological problems suffered by hat makers who inhaled mercuric nitrate vapour. Mercurous chloride in teething powders and ointments caused cases of acrodynia (pink disease) among young children in the 1900s. In the 1950s, mercury was released from a chemical plant into the Minimata Bay of Japan, contaminating fish that were consumed by fishermen and their families. Another poisoning episode occurred in the 1970s when seed grain coated with a methylmercury fungicide was mistakenly used as flour in Iraq. These incidents dramatically demonstrated mercury's neurotoxic effects, which were particularly severe among infants exposed during the prenatal period. In recent years, concern has centred on exposure to methylmercury in fish and elemental mercury from industrial and mining activities (1). Metallic Hg is liquid at room temperature and compared with other metals is highly volatile. Vapour pressure is also high and very dependent on temperature being around 14 $\mu g.m^{-3}$at 20°C and 72 $\mu g.m^{-3}$at 100°C(2).

Andren, A.W. e Nriagu, J.O. 1979. The global cycle of mercury. In: The biogeochemistry of mercury in the environment. Nriagu, J.O. (Ed.) Amsterdam: Elsevier/ North Holland Biomedical Press,. 696 p. p. 1-15.

Due to its very peculiar characteristic of forming amalgams with several metals, Hg is used for several purposes as well as in many industries, among them the chlor-alkali plants (1) The basic of

process at those industries consists of an electrolytic process over a concentrated solution of NaCl where metallic Hg (is used as a cathode) forming an amalgam with sodium. Afterwards the amalgams react with water producing caustic soda (NaOH) and releasing chlorine gas (Cl_2). Hg is also released and reused in the process (3), but losses occur to air, water bodies and surrounding soils (4, 5).

Exposure to metallic mercury in workers in a tropical chloralkali plant evaluated through urine analysis, Rio de Janeiro, Brazil.

MALM, O; CALASANS, C.F.; FERNANDES, A. P.; BASTOS, W.R. AND PFEIFFER, W.C.

Nriagu, J. O. (Ed.). 1979. Production and uses of mercury. In: The biogeochemistry of mercury in the environment. Amsterdam: Elsevier/ North Holland Biomedical Press, 696 p. p. 23-39.

The Al-Furat Company for Chemical Industry (AFCCI) is a company for production several types of chemical gases (such as Cl_2) and compounds (such as NaOH, H_2SO_4, and NaOCl) (5). Several researchers (6,. 7) found that there were alarming concentrations of mercury in the company liquid waste products that disposed in the drainage The aim of present study is; to evaluate the mercury concentrations in blood and urine of company workers who are in direct contact with mercury products and peoples affected by company disposal of mercury waste products: to estimate the duration of exposure; and age on the level of this toxic element.

Material and Method

Sampling collection:

Blood and urine samples were collected from 25 normal persons (they are not complaining from any disease); they have been divided into five groups of 5 persons.First group: involved the workers in direct contact with mercury element that they working in rooms of mercury cells (high risk group).Second group: involved workers in the hypo production (low risk group).Third group: include the management employed; they are rather far away from production units (lower risk group).Fourth group: the people enrolled in this group are living in the area located southeast the Al-Furat company and they are affected by liquid waste that disposed into Al-Ojemy drainage as well as waste products in the air(plume and smoke).Fifth group: control group, which included people from area located northeast the company, they are rarely affected by the company by-products. According to ATSDR (8), Blood and urine samples were used to test for exposure to metallic mercury and to inorganic forms of mercury.Blood samples were collected in sterile tubes (3_5 mL whole blood was collected), mixed and storage in freeze until further treatment. Morning urine samples were collected in 100-mL decontaminated polyethylene tubes, the urine specimens were filtered through a 0.45 mm Millipore membrane filter. Some 1 mL of nitric acid (65%) was added to the aliquots and stored in freeze.Digestion and sample analysis: All glassware were washed with warm water and soap, and then with distilled water, after that it washed with deionized water (DW) and placed in acid bath for 48 hour. Then, it rinsed with tape and DW. Finally, to remove any trace of oxidizing compounds,it washed with 1% HCl (9) *Geochemistry:Exploration,Environment, Analysis*;.The digestion process should not produce heat (because the mercury is evaporated rapidly), therefore, digestion is done using 1ml of mixture of HNO_3 (Nitric Acid) + $HClO_4$ (perchloric acid) and 3 ml of sample for 24 hr. The volume was completed to 10 with ammonia

buffer or 10 ml of ammonia buffer was added. Sample and blank were analyzed by CVAAS (Shimadzu, Model AA-670).

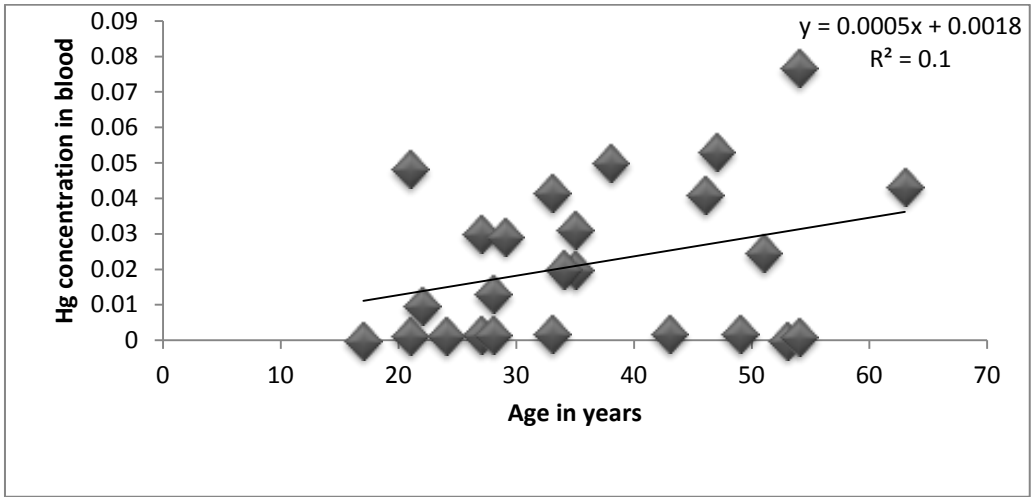
Statistical analysis

Uniform t- test, p-value, and mean, were used for statistically analyze of this work results.

Results and Discussion:

The present study was conducted to detection of elevated mercury concentrations in blood and urine samples, collected from five groups according to the potential of exposure to mercury. Group one revealed higher mercury concentration in blood (mean=0.05394 µg/ml, p-value ≥0.001) in comparison with all other groups as illustrated in Table (1). However, there are no significant differences between group four and five. Regarding the age, the people is divided into three age intervals (Table: 2). Mercuric ion is toxic to human beings because its affinity with sulf-hydral (S-H) groups in protein. The combination of Hg with those groups can interfere in biological process mediated by enzymes. Hg vapour is readily absorbed by lungs, transported by blood. So the present data showed that there was positive correlation between the age and increased mercury levels in blood (Fig: 1). Moreover, the age interval more than forty years revealed high mercury level in blood (mean=0.02691 µg/ml) in comparison with other two intervals, also there is a significant differences within age groups. Once exposure has stopped, the mercury level in the blood begins to drop rapidly, so blood tests are useful only for continuing or very recent exposures. Blood mercury levels in the general U.S. population are usually less than 5 micrograms of mercury per liter of whole blood (10) , while in this study the results showed that group 1, 2, and 3 are more than 5µg.L^{-} because they were exposure to more doses of mercury than other groups. The relation between the duration of exposure to the mercury and blood concentrations was illustrated in Table (2), the group of long period of exposure (more than twenty years) revealed an increased mercury levels in blood (mean=0.02958 µg/ml, F : 47.1409). Blood mercury levels are not considered a good predictor of toxic effects. Since the metallic mercury that is absorbed into the body is excreted almost exclusively in the urine, so urine samples provide the best indicator of exposure to this form of mercury (10. The inhalation exposure of high mercury concentrations can cause gross or mild transient proteinuria, changes in urinary acid excretion, hematuria, oliguria, and acute renal failure. Chronic oral exposure to inorganic mercury compounds also results in renal damage, and renal failure has been reported in several cases following mercuric chloride ingestion (1). As a result the exposure to high levels of metallic, inorganic, or organic mercury can permanently damage the kidneys (8), and because of this damage in oldest people, the concentration of Hg in the oldest people were less than in the youngest, and the correlation between age and urine mercury concentration (Fig, 1) revealed that the youngest people (less than thirty years), excrete higher mercury concentrations in urine (mean=127.702 µg/ml) than older (Table: 2), and as illustrated in table (3) there is a diminishing in mercury concentrations in urine with the increased period of exposure to the mercury ions and the mean mercury concentrations in urine was the lowest (16.7155 µg/ml) in the interval more than twenty years of exposure. The results of urine samples showed that the high risk group (group one) was recorded the higher level of mercury concentrations (mean= 247.6178), and there is significant difference with all other groups (p ≥0.05). Although group two showed increased Hg concentration than group three (mean=128.0960 µg/ml, and 40.6034 µg/ml, respectively), but there is no significant difference, the same criteria is happened between group three, four and five (mean=40.6034 µg/ml, 9.2312 µg/ml, and 3.7692 µg/ml, respectively)(table:1).According to ATSDR (10) (.), Urine mercury concentrations

over 10 micrograms per liter would indicate that a person has been exposed to higher mercury levels than the average population, While according to WHO (11)., the concentration under 7 µg.L^{-} urine can be considered normal for people not exposed and 50 µg.L^{-} would indicate that a person has been exposed to higher mercury levels than the average population (and some time the maximum acceptable value for occupationally exposed population, corrected to creatinine value , 50 µg.g-).



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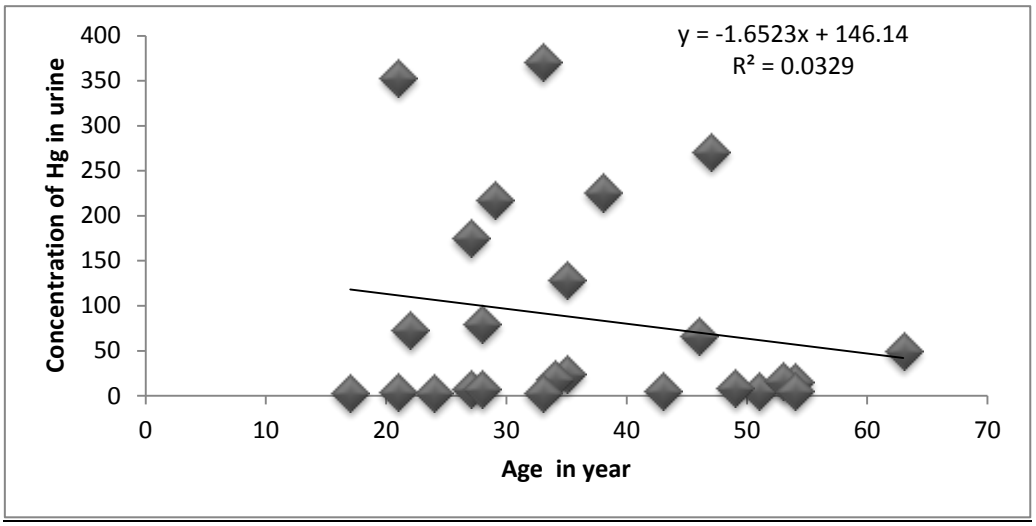

B

Fig (1): The correlation between Hg concentration in blood (A) & urine (B) with ages

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Table (1): The concentrations of Mercury in blood and urine samples, collected from five groups according to the potential of exposure to mercury in Al-Furat Company of Chemical Industries.

Groups	Hg con. in blood (µg/ml)	Hg con. in urine(µg/ml)
	0.0483	353.602
	0.05	226.005
Group one	0.0768	15.731
	0.0415	371
	0.0531	271.751
Mean	0.05394	247.6178
	0.0434	50.4
	0.03	175.582
Group two	0.0311	129.292
	0.0409	67.002
	0.0293	218.204
Mean	0.03494	128.096
	0.0198	24.802
	0.013	80.394
Group three	0.0246	5.582
	0.0097	73.017
	0.02	19.222
Mean	0.01742	40.6034
	0.0019	8.426
	0	17.002
Group four	0.0014	7.51
	0.001	5.291
	0.0016	7.927
Mean	0.00118	9.2312
	0.0019	5.173
	0	3.205
Group five	0.0017	2.9
	0.0012	4.317
	0.0011	3.251
Mean	0.00118	3.7692

Table (2): The mean of Hg concentrations in blood and urine samples, according to age interval in years.

Age interval in years	Sample size	Mean of Hg con. In blood (µg/ml)	Mean Hg con. In urine (µg/ml)
>30	10	0.01829	127.702
30-40	6	0.02001	72.3263
<40	9	0.02691	44.6873
Total	25		

Table (3): The mean of Hg concentrations in blood and urine samples, according to period of work in/ life beside Al-Furat Company.

Period of work in/life beside the company	Sample size	Mean of Hg con. In blood (µg/ml)	Mean Hg con. In urine (µg/ml)
>10	9	0.01818	114.168
10-20	6	0.0229	74.4653
<20	10	0.02958	16.7155
Total	25		

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