Determination of Mercury in Blood and Hair Samples from Chronic Exposure Workers to Mercury from Nuhran-Umarlaboratories-South Ooil Company

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Abstract

Mercury level in blood were studied for workers (4 women, 17 men) employed in Nuhran Umar laboratories/ south oil company (metallic mercury vapor exposures). Fifty (15 women, 35 men) healthy volunteers were chosen as control (non exposure group). The results have shown significant change in blood and hair mercury level between exposure and non exposure (control) groups .

حساب الزئبق في نماذج من دم وشعر بعض العمال المعرضين بشدة الى الزئبق في مختبرات شركة نفط الجنوب في نهران عمر

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الخلاصة

تم تعين تراكيز الزئبق لدى العاملين في شركة نفط الجنوب (مختبرات نهران عمر) الذين هم بتماس مع الزئبق (4 نساء و 17 رجل) حيث قورنت النتائج مع متطوعين اصحاء غير المتعرضين للزئبق بواقع (51 نساء و 35 رجل) . وجد ان هناك تغير مهم وملحوظ للزئبق في دم وشعر الاشخاص غير المعرضين .

Introduction

Mercury is a major pollutant to the environment and in our mouths in the form of "silver" amalgam. Once introduced to the body through food or vapor, mercury is rapidly absorbed and a ccumulated in several tissue, leading to increased oxidative damage, mitocondria dysfunction and cell death . (Shenker *et al* 1998) .

Mercury primarily affected neurological tissue, resulting in numerous neurological symptoms and also affected the kidneys and the immune system. (Albers *et al* 1988,Rudolfs, 2000).

It is causes increases production of free radicals and decreases the availability of antioxidant. It is also has devastating effects on the glutathione content of the body, giving rise to the possibility of increased retention of other environment toxins... distinguish those individuals who are excessively burdened with mercury and to monitor them during treatment. Therapies for assisting the reduction of mercury load include the use of 2,3-dimercaptosuccinic acid (DMSA) and 2,3 –dimercapto-1-propanesulfonic acid (DMPS).(Walter and crinnion 2000) .

Experimental

Material and Method

1- Collection of hair samples: one gram of hair was taken from each worker which was kept in a clean dry container to avoid contamination.
2- Collection of blood samples: (5) ml of venous blood was taken from each worker and was putted in a clean dry tubes contains (EDTA) as anticoagulant agent.

Reagents:

Chemicals of analytical- reagent grade and distilled-deionized water were used for the preparation of all solutions:

1- 1000 ppm Hg^{2+} solution , 1.3535 gm of $HgCl_2$ was dissolved in 50 ml of Conc. HCl and diluted to 1 L with deionized water.
2- 25% (w/v)$SnCl_2$, 25 gm of $HgCl_2$ was dissolved in 100 ml of 20 % (v/v) HCl .
3- 0.05 % (w/v) $K_2Cr_2O_7$, 0.05 gm of $K_2Cr_2O_7$ was dissolved in 2% (v/v) HNO_3 solution .
4- Crystal potassium persulphate .

Digestion of samples :

Digestion of hair samples: (1 gm) of hair sample was dissolved in (5) ml of Conc. HNO_3 and diluted to (25)ml with deionized water .

Digestion of blood samples: (2ml) of blood sample mix with (250mg) of potassium persulphate and (2ml) of HNO_3 and (0.5 ml) H_2SO_4 to which (5ml)of deionized water was added . The mixture were heated to 80 ° C for (30) min .

Analysis of blood and hair samples :

The determination of mercury in the hair and blood samples achieved by means of cold Hg vapor atomic absorption spectrometry (CVAAS) using shimadzo atomic absorption spectrophotometry model (AA 630-12) and mercury hallow cathode lamp at (253)nm .A quartz cell of 12 cm in length and (8) mm in diameter with quartz windows with in and out lets ends has been used for measurements .(Zaki 2002) .

Direct method :

Eight ml of digested hair and blood sample was introduced in reducing vessel, (2) ml of $SnCl_2$ solution was added and mixed using magnetic stirrer for (2) min then the mercury vapor forced by nitrogen gas with rate of 0.25 L/min .(Francisco *et al* 1984).

The atomic absorption signal of mercury was measured at (253) nm. A calibration graph prepared from aqueous standard Hg^{2+} solution to which $SnCl_2$ solution was added and forced by the same procedure (Fig. 1) .

Standard addition method was used by taking (2) ml of digestion blood or hair sample divided into four portions(each 0.5 ml) to which different mercury concentrations (0,10,20,30,40)ng have been added a standard calibration graph was constructed and the concentration of mercury calculated by regression of absorbance (Fig. 2).

Results

Analysis methods :

The cold Hg vapor atomic absorption methods was used for this purpose, in which two methods of calibration for the determination of Hg in hair and blood samples, one of these, the direct method ,the results obtained

by this method was found to be with good agreement when compared with the results obtained by the standard additions method (Fig.1 and Fig. 2) . The linear range for the direct method was (0-100) ng Hg. The detection limit was found to be (0.2) ng of Hg ..

Table (1 and 2) show the accuracy and Hg content in blood using the direct method as compared with the standard addition method which are found to be (97-98 %) and it is found that the blood mercury content of exposure group ranged between (16-39) ng/ml (table-3) whereas the Hg content of control group ranged between (1.12- 4.72) ng/ml , while the Hg content of hair sample for exposure group ranged between (80-224) ng/g whereas it was found to be (6-40) ng/g in control group (table-5) it has been shown that exposure group have high blood Hg content accompanied with high Hg content in hair (table-3,5).

On the other hand (table 2 and 4) show the mean Hg blood and hair contents for the selected group as compared with Hg content of exposure group.

Table (1): Accuracy of direct method compared with standard addition method .

Sample	Conc.of Hg blood (ng/ml) by direct method	Conc. Of Hg in blood (ng/ml) by standard addition method	Accuracy%
A	8.73	9.0	97%
B	4.90	5.0	98%
C	6.85	7.0	97.78%

Table (2): X & SD mercury in blood (ng/ml) for selected group compared with control group .

Selected group	n.	Hg in blood X + SD
Nuhran Umar lab. Workers	21	31.14 +7.49
Control group	50	2.921-1.87
P value		0.0000

Table(3):Concentrations of Hg (ng/ml) in blood for exposure and unexposure groups.

Conc. Of blood mercury for exposure group(ng/ml)	Conc. Of blood mercury for unexposure group(ng/ml)
20	3
18	2
16	3
30	4
32	2
24	3
22	2
30	5
32	4
34	2
36	3
34	6
35	3
39	2
38	1
36	1
38	2
35	5
38	6
39	5
37	4
	2
	1
	3
	3
	2
	1
	2
	5
	6
	6
	3
	2
	1
	1
	3
	3

Table (4): X & SD mercury in hair (ng/ml) for selected group compared with control group .

Selected group	n.	Hg in blood X + SD
Nuhran Umar lab. Workers	21	129.904 +4.742
Control group	50	16.64+0.695
P value		0.0000

Table(5): Concentrations of Hg (ng/g) in hair for exposure and unexposure groups.

#	Conc. of hair mercury for exposure (ng/g)	#	Conc. of hair mercury for unexposure (ng/g)	#	Conc. of hair mercury for unexposure (ng/g)
1	160	1	16	26	16
2	120	2	24	27	24
3	96	3	16	28	16
4	112	4	16	29	16
5	128	5	8	30	16
6	80	6	16	31	24
7	200	7	24	32	16
8	144	8	16	33	24
9	136	9	16	34	24
10	96	10	8	35	16
11	88	11	24	36	8
12	152	12	16	37	8
13	120	13	8	38	24
14	224	14	16	39	16
15	176	15	24	40	24
16	144	16	24	41	16
17	136	17	6	42	8
18	128	18	8	43	16
19	96	19	16	44	8
20	112	20	16	45	32
21	80	21	8	46	16
		22	24	47	8
		23	16	48	40
		24	16	49	32
		25	16	50	16

Discussion

Mercury has the ability to causes changes at the cellular level, which has been seen in platcets and erythrocytes.(Chang 1996 and Pamphlet and Waley 1996).

Mercury is bonded by selenium in the human body , this appears to resulting reduced amount of available selenium, which compounds have the oxidative burden on the body *(Thompson et al 1988, Kasarski et al 1993)* .

Mercury decreases the GSH levels in the body which occurs by several mechanism, mercury binds irreversible to GSH, causing the loss of up to two GSH molecules per atom of mercury, the GSH-Hg-GSH complex is excreted via the bile into the feces, part of the irreversible loss of GSH is due to the inhibition of GSH reduction by mercury (Nylander *et al* 1987, Pendergrass *et al* 1997).

Mercury levels in blood and hair assessed though this study reveals that there are a significant increase in mercury contents of blood and hair for the Nuhran Umar workers when compared with the control group, which refer to the direct metallic mercury vapor exposure and these results indicate that the exposure group to mercury may have healthy problems caused by the effect of mercury on the human body. Therefore; determination of mercury levels in blood and hair required during the working period to ensure maximum safety to workers because there is no harmless level of mercury vapor exposure. (table. 4,5).

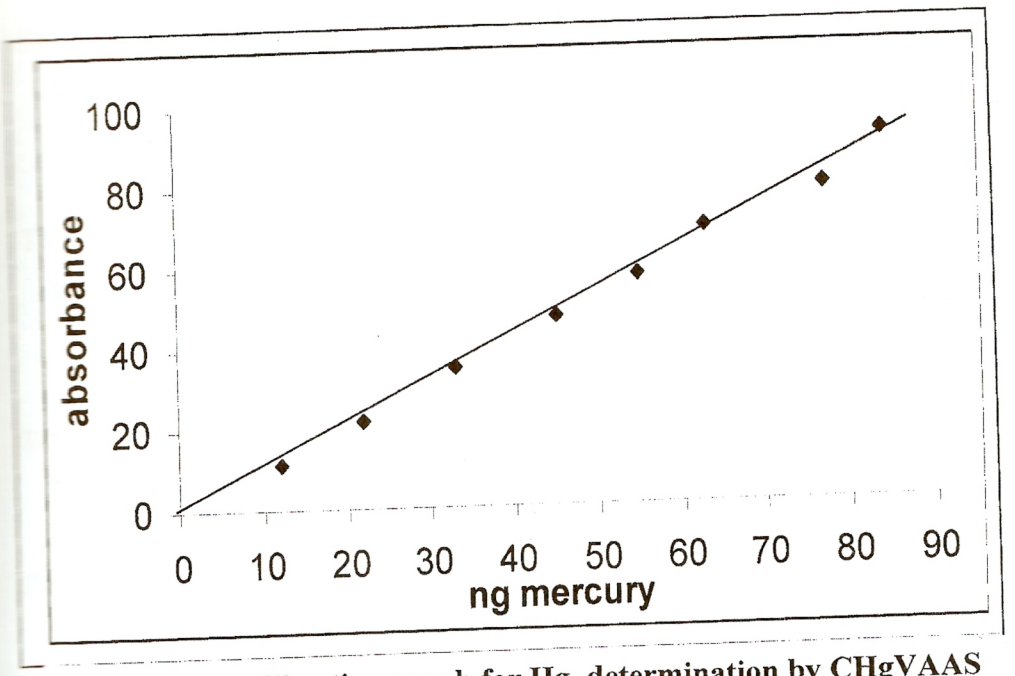

Fig.1 Direct calibration graph for Hg determination by CHgVAAS

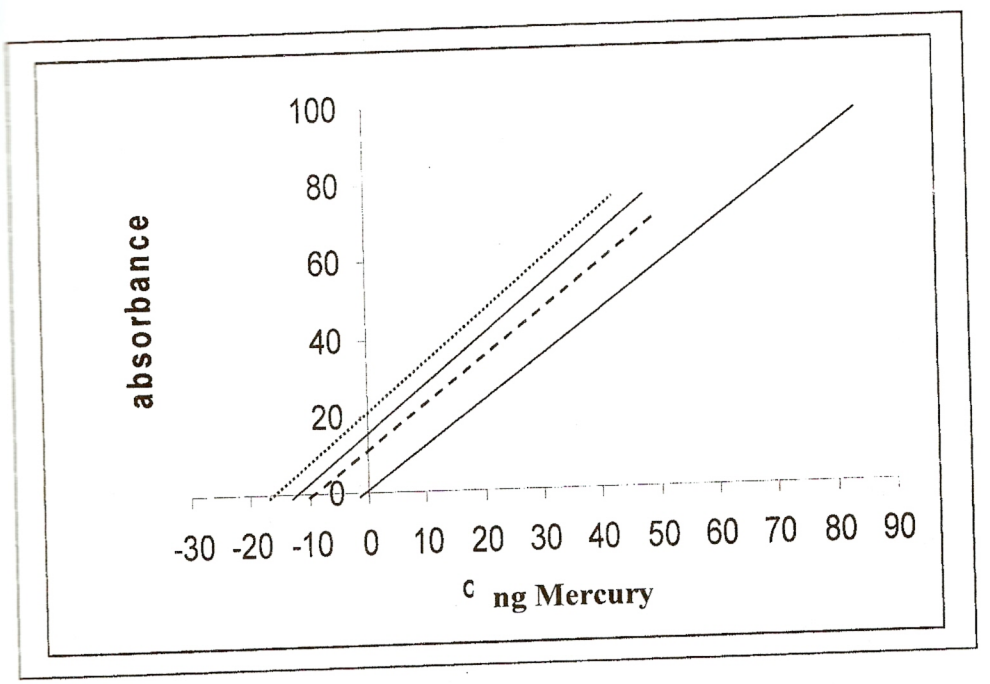

Fig.2 – Standard addition method for different blood samples

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