706

J. Comm. Med 1992, Vol. 5, No. (1)

Mercury exposure in Chloralkali Factory-Iraq

*Al-Shammary, H.A. MB ChB Dom ** Hikmet Jamil MB ChB DVD DIH AFOM MSc PhD MFOM FFOMI

* Physician in the Ministry of Health, ** Dept. of Comm. Med. Coll. of Med. Uni. of Baghdad. Iraq.

Key Words : Mercury, Chloralkali factory, Workers, Iraq.

التعرض للزئبق في معمل انتاج الكلورين والصودا الكاوية

الخلاصة :

تم دراسة ٦١ عامل (٥٠ عامل متعرض لبخار الزئبق و١١ عامل غير متعرض). أظهرت النتائج وجود علاقة معنوية (القيمة المعنوية اقل من ٠.٠٠٥) بين كمية الزئبق في الهواء لكل مجموعة من العاملين وبين المعدل الوسطي لتركيز الزئبق في الادرار لنفس المجموعة من العاملين. كما تبين ان العمال الذين لديهم خدمة اكثر من عشرة سنوات يشكون من اعراض التسمم اكثر من الذين لهم خدمة اقل. توصلت الدراسة الى توصيات تقلل من مخاطر العمل.

SUMMARY :

A total of 61 workers (50 exposed workers-EW to mercury vapor and 11 non exposed workwes-NEW) were investigated. The mean urinary mercury concentration (MUMC) was significantly differente (P<0.005) among workers exposed for different times to air born mercury level (ABML). Workers with history of exposure to mercury (Hg) for more than ten years showed higher prevalence of toxicity. Recommendation are given to reduce the work hazards.

INTRODUCTION :

Metallic Hg was known to ancient Egyptians, and is one of the oldest industrial poisons[1]. Romans reported mercurialism as a disease among slaves working in the great spanish mines of Almaden[2]. Ionsina and Al-Razi used Hg for the treatment of chronic skin diseases and syphilis in 1495 when first recognised[3]. The first appreciation of toxic effect of Hg vapour as an industrial hazards was by Ulrich Ellenborg[1]. In the year 1665 the working day of workers at Hg miners of Idria were shorten to six hours, because they suffer from hand tremor, this is said to be the first legislation measure of industrial hygiene[4]. Several studies[5-8] were carried on workers exposed to Hg vapour; all showed significant correlation between ABML and MUMC. The Iraqi National Centre of Occupational Health and Safety (INC-OHS) has previously recognised the health. hazard among chlorine production plant resulting from excessive exposure to elemental Hg vapour. This study was done according to the recommendation of the INC-OHS and with its cooperation to investigate whether MUMC could reflect the degree of exposure and to see if there is any hazard to health of the workers.

MATERIALS AND METHODS:[9]

1- The chloralkali factory in Rayon industry uses about 46 tons of Hg per year; the factory consist of three rooms, including the Hg cells (an area of 600m2 and a height of 15m) which has only natural ventilation.

2- The factory employs 61 men; only 50 workers were exposed to Hg vapour in the Hg cells room, while Eleven workers not exposed. The EW were classified into seven groups according to their Job which had a relation to time spent in the Hg cell room (Table 1).

3- For each worker, a form of questionnaire including general and specific questions were filled prior to clinical examination which was carried out at Saddam medical City by speciallist in internal medicine.

4- 20 measures of ABML were taken during 3-weeks period (july 1987) from different situation and analyzed by chemical method[10] at INC-OHS.

5- Morning urine specimens were collected and preserved in cooled containers during transport and storage. Analysis was done on the 2nd day at INC-OHS using the chemical method[10], and creatinine in urine by "Jaffe's method". Hg concentration in urine was subsequently corrected for creatinine (microgram Hg per gram creatinine)[12].

RESULTS :

Table 1, shows ABML in time-weighted average (TWA) and the MUMC for each group of EW according to different times of exposure with tests of significance. Table 2 shows the significant difference between EW and NEW for MUMC, while Fig.1 shows the significant correlation ($r=0.84$, $P<0.002$) between the ABML (TWA) and the MUMC of the corresponding group by using the regression model of the least square line correlation coefficient[13]. A significant difference ($P<0.005$) was found between the MUMC of EW using one way analysis of variance (ANOVA table) which was found to be between group(1) and (6), (1) and (7) (by testing the difference between individual pair of groups using Tukays HSD test[13] (Table 1). Weak correlation ($r=0.28$, $P<0.04$) was found between individual MUMC and duration of exposure to Hg vapour (Table 3) using spearman's rank correlation coefficient[13]. Table 4 shows the positive signs and symptoms for EW and NEW.

DISCUSSION :

The results showed that the correlation between ABML (TWA) and MUMC should be based on a group of workers rather than on individual worker. The MUMC increased with increases in ABML ($r=0.84$) as well as with long duration of exposure; this confirms that this biological factor (urine Hg) can reflect the importance of Hg exposure sustained by a group of workers which is similar to the study done by smith et al[6]. The MUMC (10.2 ± 2.7 µg/gn. creatinine) in NEW is somewhat higher than the previously estimated figure of 0-10 µg/gn. creatinine[14], this is attributed to exposure of NEW to ABML in the area surrounding the chloralkali plant. The results of questionnaire showed that the symptomatology was predominately neuropsychological and oral, which were non specific and difficult to be attributed to Hg exposure.

Table 1. Air born mercury level (ABML) in time-weighted average (TWA) and mean urinary mercury concentration (MUMC) for each group of expose workers (EW) according to different time of exposure (T.E) with test of significant.

Group No.	EW No.	T.E hr/week	ABML* TWA mg/m3	MUMC** µg/g creatinine	umc rang µg/g creatinine
1	8	36	0.0675	140.3	34-326
2	3	30	0.0560	84.0	27-150
3	8	24	0.0450	56.4	10-163
4	8	18	0.0338	53.0	18-171
5	2	12	0.0225	52.0	39-65
6	10	6	0.0113	17.1	7-56
7	11	4	0.0078	14.3	5-53

* The correlation between ABML (TWA) and individual urinary value (r=0.31, p-0.03)
** Significant difference (p<0.005) between EW and MUMC using one way analysis of variance and the differente was found to be between group 1 and 6, 1 and 7, using tukeys HSD test.

Table 2. The significant difference between EW & NEW for mean and standard deviation of mercury concentaration in mg/g creatinine (MUMC ± SD).

Worker	No.	MUMC ± SD µg/g creatinine	t-test	P
EW	50	59.5 ± 59.4	5.6	<0.01
NEW	11	10.2 ± 8.95		

Table 3. Distribution of EW according to urinary mercury level (UML) by the duration of employment

Years of empolyment	Total No. of urine exam.	No. of EW with UML - µg/g creatinine					
		-10	11-	51-	101-	150+	range (5-326)
<-1	2	2	--	--	--	--	7-9
1-5	14	3	4	2	2	3	5-326
6-10	6	2	2	2	--	--	6-88
11-15	6	2	4	--	--	--	5-50
16+	22	3	12	5	--	2	5-171
Total	50	12	22	9	2	5	

The correlation between individual UML and years of employment r=0.28, p<0.04.

Although further study is recommended, one sure to Hg vapour as other studies have can relate th

Table 4 : Positive sign and symtoms in the Expose workers (EW) and 11 Non expose workers (NEW).

Clinical manifestation	EW (50)		NEW (11)	
	No.	%	No.	%
Symptoms				
Loss of memory	18	36	–	–
Irritability	16	32	2	18
Parasthesia	14	28	–	–
Nervousness	8	16	2	18
Sleep disturbances	5	10	1	9
Inability to concentrate	3	6	–	–
Decreased appetite	3	6	1	9
Salivation	2	4	–	–
Urinary troubles	1	2	–	–
Loss of weight	1	2	–	–
Signs				
Gingivititis	10	20	–	–
Tremor	7	14	–	–
Weak or absent deep reflexes	6	12	–	–
Visual or disturbance	3	6	–	–
Incoordinated movements	2	4	–	–
Loss of teeth	1	2	–	–
Dermatitis	1	2	–	–

Note : Out of 50 EW, 23 gave either one or more positive signs or symptoms.

Recommendation include improving general ventilation, immediate cleaning of any spillage of Hg from the cells, droplets of Hg should be treated by Hg absorbent, and personal hygiene as well as medical care of the workers.

ACKNOWLEDGEMENTS:

We gratefully acknowledge the general director and staff of the Rayon industry; Dr. J.K Al-Ajzan (director of INC-OHS) and Miss R. Al-Assaf (senior chemist in INC-OHS) for their help in analyzing the samples.

REFERENCES :

1- Caral Zenz. Occupational medicin, principle and practical application, 1975, p : 668-75.

2- Hamilton, A., and Hardy, H.L. Industrial toxicolosy ed. 3. 1974, p : 131-49.

3- Goldwater, L.T., Ladd, A.G. and Jacobs, M.B. Absorption and excreation of mercury in man. Arch. Environ. Health, 1964, 9 : 735-40.

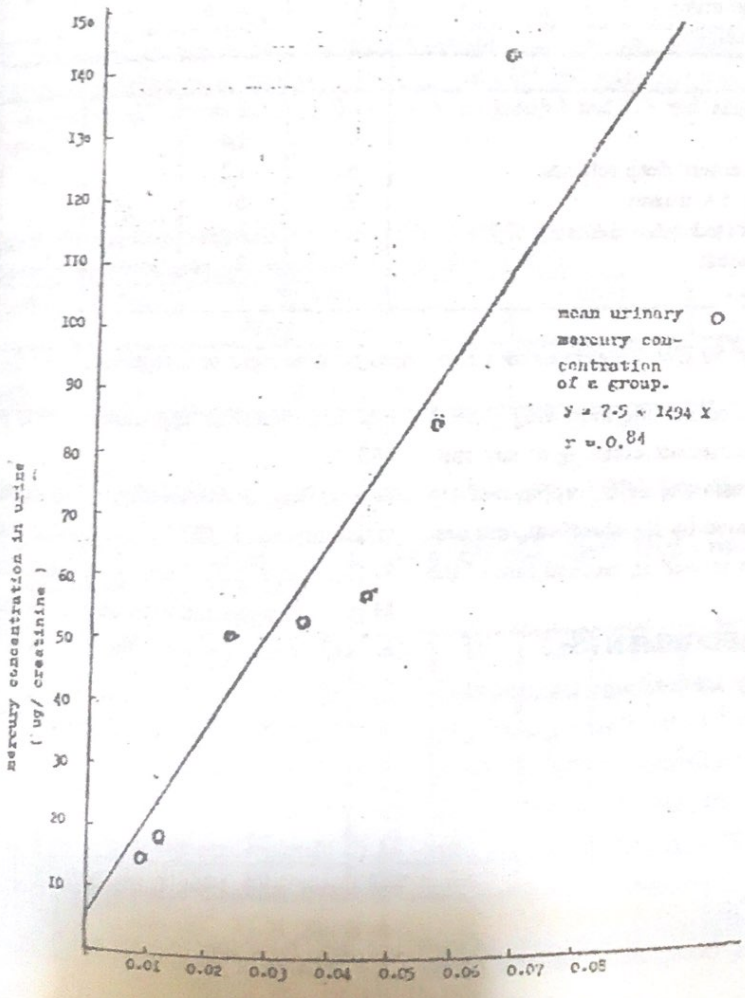
4- Hunter, D. The disease of occupation ed. 6. 1978, p : 305-42.

5- McGill, C.M., Jacobs, M.B. and ladd, A.C. Mercury exposure in chlorine plant. J. of occup. med. 1964, 6, (8), 335-7.

6- Smith, K. G., Vorwald , A. J. and Patel , L.S. Effects of exposure of mercury in the

710

Fig. (F) The relation between mercury concentration in air (TWA exposure level) and in urine (on group basis).



manufacture of chlorine. Amer. Ind. Hyg. Assoc. 1970, 31, p : 687.

7- Lauwerys, R. and Buchet, J.P. Occupational exposure to mercury vapor and biological 'action. Arch. Environ. Health. 1973, 27, p : 65-8.

8- Lindstedt, G., Gottberg. I. and Holmoren, B. Individual mercury exposure of chloralkali workers and its relation to blood and urinary mercury levels. Scand. J. of work Environ. Hyg. 1979, 5, p : 59.

9- Al-shammary, M.A. Mercury exposure in chloralkali factory. A dissertation submitted to Dept. of Comm. Med. Coll. of Med. Uni. of Baghdad-Iraq 1987.

10- Analytical lab. Instr. Manual. Dept. of Occupational Health and Hyg. Newcastle Upon Tyne 1977.

11- Varley, H. Gowenlook, A.H. and Bell, M. Practical clinic biochemistry, 1980,1, p : 484.

12- Wallis, G. and Barber, T. Variability in urinary Hg excretion. J. occup. med. 1982, 24, (8), 590-5.

13- daniel, W. Biostatistics. A foundation for analysis in the health sciences. ed. 3 1983, p : 177, 206, 271, 421.

14- EEC, Occupational health guides for chemical risk. Luxamburg, office for clinical publications of the Earopian countries 1983.