

Potential 2,3,7,8-tetrachlorodibenzo-p-dioxin exposure of Seveso decontamination workers

A controlled prospective study

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GHEZZI I, CANNATELLI P, ASSENNATO G, MERLO F, MOCARELLI P, BRAMBILLA P, SICURELLO F. Potential 2,3,7,8-tetrachlorodibenzo-p-dioxin exposure of Seveso decontamination workers: A controlled prospective study. *Scand j work environ health* 8 (1982): suppl 1, 176—179. In 1976, an explosion at the Industrie Chimiche-Meda-Società Azionaria (ICMESA) plant in Meda, near the Italian town of Seveso, released a cloud of aerosol containing 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), which contaminated the surrounding area. Clean-up of the highly polluted area of Seveso started on May 1980; in order to avoid exposure to significant levels of TCDD, safety measures are being used, but a potential exposure cannot be ruled out. A prospective study was set up at the beginning of the clean-up procedures, and laboratory tests are being used to evaluate trends among the decontamination workers. A reference group who met eligibility criteria at the preemployment examination was selected from employees of the same firm employing the decontamination workers. Medical examinations and laboratory tests have been performed on both the exposed and nonexposed groups at the same facilities. Analysis of the first follow-up period did not show any remarkable changes in a battery of laboratory tests of the exposed and nonexposed groups.

Key terms: clean-up workers, dioxin, occupational epidemiology, occupational safety.

In 1976 an explosion due to a run-away reaction occurred at the Industrie Chimiche-Meda-Società Azionaria (ICMESA) factory in the north Italian town of Meda and released a cloud of aerosol which contaminated the surrounding area of 18.64 km². The aerosol, a chemical mixture consisting primarily of sodium trichloro-

phenate (TCP), contained an extremely toxic by-product, 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). The affected area was subsequently divided into three zones. Zone A, an area of 1.08 km² in the towns of Seveso and Meda, just south of the plant, was contaminated with the highest levels of TCDD. The soil TCDD content in this area ranged from 0.75 to 20,000 µg/m² (1). The biological effects of TCDD exposure on the general population have been described in other reports (2, 3, 4, 5, 6, 7). Detailed descriptions of the legislative and medical procedures to monitor adverse effects of TCDD in the population living in the areas surrounding the ICMESA plant have already been published.

The existence of a hazard in the decontamination procedures was shown 4 a after

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the Badische Anilin und Soda Fabrik (BASF) episode in which a worker was assigned to repair one of the autoclaves. Although he was wearing protective devices, including a mask, he lifted the mask several times to wipe-off the sweat from his forehead. Four days later, acute dermatological and neurological disorders developed; six months later he was admitted to a hospital for pancreatitis and liver enlargement. After nine months the patient died, and the autopsy revealed pancreatic necrosis, liver abscesses, and chloracne of the trunk.

Evaluating a possible TCDD exposure of the clean-up workers is difficult due to the lack of reliable biological indicators and, especially, indicators showing a good dose-response relationship. Therefore, it is cumbersome to evaluate whether protective devices actually prevent exposure to TCDD. The clean-up operation in the highly polluted zone A began late in May 1980; special attention was paid to compliance with the safety rules by the workers. The workers hired for the decontamination procedures had never worked in the polluted area. The clean-up operations consisted of repeated removal of top-soil layers until values of TCDD lower than $5 \mu\text{g}/\text{m}^2$ were found. Appropriate measures to reduce dust levels have been used, such as wetting the materials being treated. The average dust concentration was as high as $0.02 \text{ mg}/\text{m}^3$, the highest value being $0.09 \text{ mg}/\text{m}^3$ (dust monitor RDM 301).

The implemented safety measures, ie, wearing of protective suits, whole face masks, gloves and special boots, adherence to a precise set of procedures in the "auxiliary units" before wearing and after taking-off protective devices, and showering before putting on personal clothes, should prevent any significant exposure to the toxic agent, but a potential exposure cannot be ruled out. Our study was aimed at evaluating the effectiveness of the procedures during the clean-up of the most polluted areas.

Subjects and methods

All the subjects were selected at the pre-employment medical examination, and

anyone not meeting the following eligibility criteria was excluded:

- a. absence of clinical signs of acute or chronic diseases, such as viral hepatitis, diabetes, chronic bronchitis, etc;
- b. males between 18 and 55 a of age;
- c. values of the following laboratory tests not exceeding the "normal value": serum glutamate-oxalacetate transaminase, serum glutamate-pyruvate, gamma glutamyl transferase, alkaline phosphatase, total bilirubin, cholesterol serum level, triglycerides, total serum proteins and electrophoresis, prothrombin time, thromboplastic partial time, hematocrit, hemoglobin, white blood cells and differential, total urinary porphyrin;
- d. no signs of peripheral nerve impairment detected by electromyography;
- e. lung function tests (forced vital capacity and forced expiratory volume in 1 s) within normal ranges.

A standardized questionnaire with particular emphasis on liver related-symptoms was administered at the time of the medical examination. The exposed and nonexposed groups finally included 36 workers each. The mean age of the exposed and nonexposed groups was 31.2 and 32.7 a, respectively. The level of education, smoking habits, and alcohol consumption was similar in the exposed and nonexposed groups. The only difference was observed in previous exposure to hepatotoxic agents (3 exposed vs 7 nonexposed).

Results

Results of the laboratory tests at the pre-employment examination and at the last visit are reported in table 1. No significant changes were detected. The 36 clean-up workers were divided into three subgroups according to the number of hours spent in zone A at the time of the last examination: 7 had been working in decontamination procedures less than 200 h; 9 from 201 to 400 h and 20 for more than 400 h. The results of the laboratory tests of these three subgroups did not differ after six and nine months of exposure.

Table 1. Results of various laboratory tests of the clean-up workers at the preemployment and last examination and of the reference group at the last examination.

Laboratory tests	Exposed group				Nonexposed group after six months (N = 31)	
	Preemployment examination (N = 36)		After nine months (N = 33)		Mean	SD
	Mean	SD	Mean	SD		
Total urinary porphyrin ($\mu\text{g/g}$ crea)	90.90	43.61	70.75	24.28	71.77	27.82
Serum glutamate-oxalacetate transaminase (U/l)	16.36	3.77	14.22	4.42	16.03	14.02
Serum glutamate-pyruvate (U/l)	18.64	5.49	16.06	6.12	18.52	11.03
Alkaline phosphatase (U/l)	28.42	8.64	29.72	7.01	31.19	8.82
Gamma glutamyl transferase (U/l)	20.50	12.18	20.28	8.66	20.35	9.53
Total bilirubin (mg/dl)	0.67	0.14	0.59	0.16	0.56	0.14
Thromboplastic partial time (s)	26.22	2.30	29.13	2.25	28.76	1.98
Hemoglobin (g/dl)	15.78	0.75	16.28	0.84	28.76	1.02
White blood cells ($\times 10,000/\text{mm}^3$)	6.77	1.30	6.30	1.39	7.14	1.75
Platelets ($\times 10,000/\text{mm}^3$)	199.61	39.09	204.36	38.93	194.45	42.71
Albumin (g/dl)	4.70	0.31	5.02	0.22	4.95	0.30
Gamma globulin (g/dl)	1.17	0.19	1.11	0.18	1.04	0.19
Cholesterol serum level (mg/dl)	190.51	45.70	192.28	37.44	197.90	39.75
Triglycerides (mg/dl)	113.66	48.64	125.22	52.71	141.93	107.41

Discussion

The relevance of controlled studies on the effectiveness of the protective devices to be used in the clean-up of TCDD-polluted areas has been shown by the severity of the presented BASF episode.

Since the beginning of our study, three subjects of the exposed group have been considered no longer eligible according to a job fitness evaluation: one because of a slight increase in liver enzymes, the second because of a positive hepatitis B serum antigen (HBS-Ag), the third because of a trauma that occurred in a car accident. In the control group five subjects did not show up at the follow-up examinations. The failure to find any remarkable difference, between the exposed and nonexposed, as well as the lack of any dose-response effect, indicates that, if any exposure to TCDD has occurred over the follow-up period, it has been very low. Furthermore, the total urinary porphyrins, which are considered sensitive indicators of TCDD exposure, did not show any change when compared to the preemployment values. It is therefore possible to assume that the safety measures used dur-

ing the clean-up operations were effective, also from the point of view of workers' compliance, reducing the absorption of TCDD to almost zero. The small sample size and the high variability shown by the parameters under study do not allow us to rule out the possibility that a slight effect could have occurred, in spite of our negative results. However, a more definitive analysis will be possible at the end of the clean-up operations and the follow-up. At that time the long-term effects due to a potential TCDD exposure can be considered.

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