Remote Consequences of PCDD/Fs Exposure in Subcohort of Highly Exposed Workers of Phenoxyherbicide Production in the City of Ufa

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Introduction

Results of studying remote consequences of high exposure in cohorts exposed to PCDD/F as a result of accidents in the process of industrial production and usage of phenoxyhebicides have been published in numerous publications. However only some of them are considered to be thoroughly studied and reliable, i.e. there are experimental confirmations of high exposure (data on PCDD/Fs determination in biological tissues), clinical and epidemiological research has been carried out in compliance with required criteria for representative sampling, latent period, control groups, methods of evaluation of parameters and their reliability, etc. [1].

An incident with workers who produced 2,4,5-T and TCF in the 60-80s in Ufa was described earlier [2,3]. PCDD/Fs determination in blood of workers was performed in two stages. The first stage was carried out in 1992 [3]. The second was performed in 1996-1998 at the laboratory of the Environmental Research Centre [4]. For the Ufa cohort analysis of some parameters of remote PCDD/Fs exposure was made. Increased probability of carcinogenic disease rate for the 2,4,5-T cohort [5] and changes in sex ratio of children of highly exposed donors were shown [6]. Some parameters of disease rate in the 2,4,5-T group [7] were studied. Changes in immune status of the exposed workers were evaluated by the pattern "case-control" [8]. For 6 exposed donors the period of PCDD/Fs half-removal was evaluated [9].

Objects and Methods

PCDD/Fs determination in blood samples of 75 former workers of different Khimprom shops was made in 1996-1998, 20-30 years after the maximum exposure. Methods of PCDD/Fs determination in blood were described earlier [10].

Table 1. Major parameters of the risk group and control group of donors in Ufa

Group	N	Age	2,3,7,8-TCDD	TEQ of the sample
			pg/g of blood lipids	
Men workers, 2,4,5-T	32	57.1	97.2±64.4	156.8±88.6
Women workers, 2,4,5-T	9	56.0	127.3±94.7	163.9±111.1
Workers, 2,4,5-TCP, TCP-Cu	4	55.0	318±242.6	490.3±290
Workers, 2,4-D production	24	52.0	98.1±104.2	243.3±172.5
Workers, chlorbenzene, MCPA	6	54.1	53.9±28.7	128.2±79.5
Unexposed donors (control)	44	54.7.	21.9±13.1	43.5±22.8

The following points were specified: occupational route of workers, chloracne cases in 1967-1968, smoking status, height/weight ratio, number and sex of children born, diagnoses of earlier diseases. Analysis of mortality rate in the cohort was carried out by the database on the workers mortality of the whole plant and also of the shops of dioxin hazardous production for 1964-1992 [5]. Information on death cases for 1992-1998 was acquired in the plant services, municipal statistics agency and as a result of workers' families questioning. Post-mortem diagnoses were verified, death cases of cancer, cardiovascular disease and of other causes were set apart. Data on the population of the region and the city of Ufa for the same years obtained from the statistics agency were used as test data.

Data on PCDD/Fs determination in blood of cohort representatives permitted to separate a group of highly exposed donors for whom analyses of immune status and general disease rate were carried out. Standard mortality rate for a generalised cohort and highly exposed workers of 2,4,5-T production was calculated in relation to the age, date and cause of death.

Results and discussion

A united group of workers included the workers who had worked in 2,4,5-T production shop for not less than 1 year and the workers of TCF and 2,4-D production shops who had worked there for more than 10 years. The group consisted of 189 people, for 94 of them PCDD/Fs content in blood was known either in 1992 or in 1997-1998, or both. High exposure group (>150 mg/g lipids in 1997 or >2000 pg/g lipids during the period of peak exposure) consisted of 38 people. Calculation was made in accordance with kinetics of removal of 1 order (the period of half-removal is 7.4 years) for the date of the supposed peak exposure: 1967 – for 2,4,5-T and 1975 – for TCP. When analysing chloracne cases of the Khimprom workers no dependence was found between the fact of disease in 1965/67 and the residual level of PCDD/Fs content in blood in 1997.

Table 2. Chloracne cases (1966/67) and the mean level of PCDD/Fs content in blood of Ufa united cohort representatives (pg/g lipids)

Chloracne	n	2,3,7,8-TCDD				TEQ			
		min	max	med.	mean	min	max	med.	mean
Yes	32	30.7	361.4	101.1	113.3±75.8	74.6	439.1	140.5	165.8±92.1
No	31	11.9	560.7	65.5	108.5±80.7	16.5	845.3	141.1	220.0±192.3

During examination in 1984 4 death cases were stated. Among 39 examined cohort representatives 6 people with oncologically burdened family heredity were found [2].

For the period of 1965-1998 there were 43 death cases out of 189 cohort representatives of all causes. Standard mortality rate was SMR=2.41 (95% CI, 2.01-2.82), data on the city of Ufa population served as test data. Considerable contribution to high values of the total mortality rate was made by cases of traumatism and accidents (n=7). In the same cohort there were 11 lethal cases of oncologic diseases and 8 lethal cases of cardiovascular diseases.

Mortality rate of oncologic diseases for the united group was SMR=4.56 (95% CI, 3.2-5.6). Cases of liver cancer (2), throat cancer (1), stomach and esophagus (3), blood (2), lip cancer (1) and 2 cases of undetermined diagnosis were registered. Most high mortality in the united cohort is of cardiovascular diseases SMR=3.39 (95% CI, 2.66-4.12).

For the workers of the subcohort with high exposure for the period of control 1992-1998 (after appearance of the first data on PCDD/Fs content in blood) [3] 8 lethal cases out of 38 were registered, SMR 2.67 (95% CI, 0.93-4.41). In this case data on the population also served as control data, there were 3 deaths of cardiovascular diseases, SMR 6.06 (95% CI, 1.4-13.5). Deaths of traumas and accidents –2. In the subcohort of highly exposed donors there were 3 lethal cases out of 42 (diagnoses – leukaemia, throat cancer, lip cancer). SMR 4.74 (95% CI, 1.97-11.47).

When analysing immune status of 20 highly exposed donors as compared to the control group the absence of statistically significant differences in the content of main subpopulations of lymphocytes (CD3+, CD4+, CD8+, CD72+, CD16+) and main classes of immune globulins was stated. In blood of cohort representatives lymphocytes CD10 (CALLA/J5) were detected, with no signs of morphological immaturity. When analysing disease rate the increased levels of neoplasm diseases, locomotion system and nervous system diseases were stated. In the "case-control" group for 2 years of research there were 2 cases of death in the group of exposed donors while in the control group there were none. Main results are given in Figure.

PCDD/Fs content in the blood of 3 dead people 1-3 months before they died is known. It was 250 pg/g of blood lipids (insult case), 340 pg/g of lipids (leukaemia), 280 pg/g of lipids (cardiovascular disease). There were 3 lethal cases in one family (father and 2 sons worked in 2,4,5-T shop and died at the age of 69, 53 and 51 respectively), in two cases there was an oncology diagnosis, the third was caused by insult.

Conclusion

As a result of studying remote consequences of PCDD/Fs exposure an increased mortality rate exceeding that of the city and the region population for the workers of Khimprom plant as a whole, for the workers of chlororganic production (the united cohort) and for the subcohort of highly exposed workers 20-30 years ago involved in 2,4,5-T and 2,4,5-TCF production was stated.

The cohort in Ufa has a sufficiently high level of experimentally confirmed exposure (about 2/3 of the whole group), the mean current level of contamination (1997) is about 200 pg TEQ/g lipids what by 4.5 times exceeds the background level of the corresponding age group of the city population.

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Figure 1. Some parameters of remote consequences of PCDD/Fs impact