Cytogenetic Characteristics in Herbicide 2,4,5 - T and 2,4 - D Production Workers

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Introduction

Mutation changes in the genetic substance induced by environmental mutagens produce harmful genetic effect on human health bringing about mutation in sex and somatic cells. Sex cell mutation creates genetic risk of hereditary diseases and congenital developmental defect, while somatic cell mutation changes result in various diseases including cancer [5].

In the recent 15 - 20 years the extensive list of ecological disasters endangering the civilization has been expanded by one more : the possibility of the universal environmental poisoning with dioxin and its related compounds [1, 2]. Dioxin and numerous dioxin - related substances are the ones alien to the living organism (xenobiotics) which find their way to biosphere with numerous technology fallouts. Dioxin microadmixtures characterized by a complex of unusual physical and chemical properties and unique biological activity can become one of the sources of the most dangerous long - term biosphere poisoning.

Considering the medical aspects of the problem it is necessary to emphasize that dioxin and any xenobiotic effect on the living organism is many - sided and largely depends on the poison dose, mode of its invasion, age and condition of the body.

2,4,5 - trichlorphenol and 2,4,5 - T herbicide were manufactured at the Ufa Chemical plant in accordance with conventional dioxin producing technology.

Experimental 2,4,5 - trichlorphenol production was started in 1961 and industrial 2,4,5 - T

output in 1969. Besides dermal sebaceous follicular lesion (chlorachne) in the workers involved in 2,4,5 - T production associated disorders of liver, nervous system, lipid metabolism impairment and others were determined as well [8].

In 1968 the workshop was transferred to 2,4 - D production, 2,4,5 - trichlorphenol production was discontinued in 1987. The workers involved were followed - up in 10 to 30 years after their contact with xenobiotics which enabled to determine more accurately the aftermath of their involvement. Clorachne signs were observed to have their effect on average for as long as 26 years. Under these conditions the problem of low chemical mutagens doses and those mutagenesis peculiareties which specify their chronic effect becomes very acute. The estimation of chromosome aberration (CHA) incidence in the peripheral blood lymphocytes culture makes it possible to reveal mutagenesis level in somatic cells against the metabolic disturbances occuring in the body following the combined effect of the factors involved. Chromosome impairment study enables to observe the inheritance disturbance dynamics which is of great importance for genetic monitoring of man's population and the professional groups of « high genetic risk ».

The present paper is concerned with the study of professional dioxin contained poisons effect on cytogenetic peripheral blood lymphocytes characteristics in Ufa workers.

Experimental Methods

The workers involved in 2,4,5 - T butyl ether and 2,4 - D (dichlorphenoxiacetic acid) herbicides production were studied. The chromosomal analysis in peripheral blood lymphocytes in 19 workers - group 1 (two females, 17 males aged 28 to 60 years) was carried out. The control group 2 (N 36) including donors having no harmful professional contact were investigated. The hospital staff (N 21) working in a close vicinity of « Khimprom » was included in group 3.

The blood drawn from the vein was cultured according to the conventional methodics (Hungeford method) for 48 hours following FHA infusion as the majority of cells are at the first mitosis stage at this time. The chromosome preparations were dyed with Gimsa fluid dye solution for 10 minutes to count chromosome aberrations. The chromosome aberration analysis was carried out by standard photomicroscopic preparation test at 100 metaphase from each person. Chromatic and chromosome aberration types were registered according to WHO classifica-

tion. The mean (M) value, the mean square deviation (m), mean fault, difference authenticity among the mean values were determined in each group for every value studied.

Results and Discussion

According to almost all investigators findings the incidence of chromosome aberration cells in healthy people amounts to about 1 percent. Chromatic type aberrations (single fragments mostly) make 50 - 70 % of all aberrations. When comparing the populations effected to different extent by mutagenous factors no strict age selection is required, as 10 - year difference brings about insignificant increase in chromosome aberration incidence [3].

It should be noted that in case of chemical mutagenesis in contrast to radiation one chromosome break incidence is considered but not aberration number when analysing distribution type.

The findings, we have obtained, show that the average CHA cell incidence makes 2,18 ± 0,32 in control groups (2 and 3) and 2,29 ± 0,34 (M ± m) respectively which exceeds the mean spontaneous chromosome aberration incidence [3].

Chromatic type aberrations (single fragments) make 71,07 % (group 2) and 72,43 % (group 3), chromosomal type aberration (pair fragments) make 25,21 % and 27,57 % respectively.

The mean CHA cell incidence among the workers of group 1 considerably exceeds the one we have registered in the control groups and makes 4,47 ± 0,75.

The CHA cell incidence was observed to have considerable variants within one group of workers.

According to a. m. Pilinskaya's findings (1986) in the group of workers coming into contact with similar compounds concentration the effect induced is also characterized by considerable variations irrespective of contact length with pesticides. This appears to be due to the individual sensitiveness to chemical compounds effect. As a rule, aberration incidence is characterized by « saturation limit », it fails to increase with the increase of length of work.

The analysis of chromosomal aberration spectrum showed that chromatic type aberrations (single fragments) in the experimental group (group 1) amount to 55,85 % while chromosomal type aberrations (pair fragments) make 44,15 %.

Considerable increase in both chromatic type aberrations 2,53 ± 0,48 in comparison with the control 1,72 ± 0,28 (group 2), 1,76 ± 0,32 (group 3) and chromosomal type 2,0 ± 0,32 - 0,61

± 0,15 (group 2), 0,67 ± 0,28 (group 3) respectively was revealed in the lymphocytes of « Khimprom » workers.

This increase is largely due to chromosomal type aberrations (pair fragments). It suggests that this chemical mutagen (2,4,5 - T and 2,4 - D) affects various cellular cycle phases which is proved by the discovery of chromosomal type aberrations in lymphocytes. It occurs in case of mutagen effect on G_0 stage of cellular cycle and the effect of chromatic type aberrations on G_2 stage. The aberrations of the both types are observed in effect on S stage.

Thus, we have discovered that the mean CHA cell incidence in the control groups (group 2 and 3) in Ufa twice as many exceeds the average level of spontaneous aberrations [3]. At the same time there was no difference in all values as regards their place of work and residence area in Ufa.

The cytogenetic values in the experimental group (group 1) coming into contact with 2,4,5 - T and 2,4 - D demonstrate that the « Khimprom » production area exercises marked mutagenetic effect on man.

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Results of cytogenetic study of workers are given in table 1.

Table 1

Distribution of different types of chromosomal aberrations in experimental and control groups

Aberration type	Number of aberrations					
	Per 100 metaphases			% of total number		
	group 1	group 2	group 3	group 1	group 2	group 3
Mean incidence of chromosomal aberrations cells	4,47± 0,75	2,18±0,32	2,29±0,34			
Chromosomal breaks	4,53±0,76	2,42±0,36	2,43±0,37	100	100	100
Chromosomal aberrations Single fragments	2,53±0,48	1,72±0,28	1,76±0,32	57,40	71,07	72,43
Chromosomal aberrations Pair fragments	2,00±0,32	0,61±015	0,67±0,28	42,60	25,21	27,57
Other endoreduplications		0,11±0,05				
4 N		0,08±0,05				

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