Occupational exposure to aldrin: clinical and laboratory findings

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Avar, P., and Czeglédi-Jankó, G. (1970). *Brit. J. industr. Med.*, 27, 279-282. **Occupational exposure to aldrin: clinical and laboratory findings.** The paper reports the relation of neurological symptoms and EEG findings to the concentration of HEOD in whole blood. Fifteen men who had been making aldrin in a fertilizer plant for up to five years were examined in the last month of exposure. Three of them were followed up for seven months after cessation of exposure. Eight were examined on one occasion two years after their last period of exposure to aldrin.

Some men in whom the HEOD concentrations in whole blood were above 0.10 ppm had symptoms of poisoning but these were absent in others with higher (0.25 ppm) concentrations. In three men severely affected at the time of cessation of exposure, symptoms ceased within seven months. Symptoms that were still present in others two years later are ascribed to occupational exposure to lindane.

After cessation of exposure, the concentration of HEOD in whole blood fell slowly, initially at a rate corresponding to a biological half-life of 50 to 150 days. Later, it fell more slowly, so that two years after the cessation of exposure the concentrations of HEOD in whole blood were still higher than in the general Hungarian population.

The concentrations of HEOD¹ in the whole blood of the general population (Hunter, Robinson, and Richardson, 1963; Dale, Curley, and Hayes, 1967; Laws, Curley, and Biros, 1967), of male volunteers ingesting HEOD (Hunter and Robinson, 1967; Hunter, Robinson, and Roberts, 1969), and of workmen in plants manufacturing aldrin or dieldrin or both (Brown, Hunter, and Richardson, 1964; Hayes and Curley, 1968) reflect both the duration and intensity of exposure. Occupational over-exposure to these two compounds produces signs of excitation of the central nervous system and, in severe poisoning, convulsive fits with generalized dysrhythmia in the electroencephalogram (EEG)

(Spiotta, 1951; Hayes, 1959; Hoogendamm, Versteeg, and de Vlieger, 1965). The relation of clinical symptoms and EEG findings to the HEOD concentration in whole blood was studied by Kazantzis, McLaughlin, and Prior (1964).

The value of the estimation of HEOD in whole blood in monitoring the exposure of the general public and of persons who are occupationally exposed has been demonstrated by Hunter, Robinson and Jager (1967) and in animal experiments by Keane and Zavon (1969). In the general population of Hungary, only very small amounts of HEOD in whole blood (<0.002 ppm) have been demonstrated (Czeglédi-Jankó, 1969), but we have found much higher HEOD concentrations in whole blood in men who make aldrin.

The present paper discusses the relation between clinical symptoms and EEG findings, and the concentrations of HEOD in whole blood of such workers.

¹1, 2, 3, 4, 10, 10-hexachloro-*exo*-6, 7-epoxy-1, 4, 4a, 5, 6, 7, 8, 8a-octahydro-1, 4-*endo*, *exo*-5, 8-dimethanonaphthalene, the active ingredient of the pesticide dieldrin. The active ingredient of aldrin has a carbon double bond instead of the epoxy-group.

Subjects and methods

Fifteen men – 3 chosen because they had symptoms, and 12 chosen at random – out of 40 workers exposed to aldrin in a fertilizer plant manufacturing aldrin, were examined during the last month of exposure (in 1967) after some years of intermittent occupational contact, with a follow-up of 3 men for seven months and with an examination, two years later, of 8 men, 4 of whom (nos. 16 to 19) were not among those examined in 1967.

The examination included a neurological history and examination, EEG, and a sample of whole blood. In the assessment of the clinical symptoms the degrees of abnormality were marked as: 0, no changes; +, minor symptoms and signs; ++, more serious symptoms, viz., muscular jerking and myoclonia with emotional changes; and +++, convulsing fits, as in epilepsy, witnessed by others, with sequelae, trauma, and psychic disturbances. Similarly, the EEG record was measured as: 0, no changes; +, increased variation in the frequency and amplitude wave pattern; ++, preconvulsive changes; and +++, typical convulsive changes.

The concentration of HEOD in 5 ml of whole blood was determined by gas liquid chromatography, using an electron-capture detector, as described by Czeglédi-Jankó and Ciesleszky (1968).

Results

The findings of the medical examination and the analysis of whole blood are presented in the Table. The subjects are listed in order of decreasing concentrations of HEOD in whole blood. Subjects 1, 2, and 8, with a history of poisoning, were studied for seven months and the concentrations of HEOD in whole blood were determined (Fig. 1). The concentration of HEOD at the time of an episode of poisoning in subject 1 is extrapolated from the values determined during the ensuing seven months. No further exposure to aldrin occurred and the concentration of HEOD fell. The severity of change in the EEG record is also shown. Records of the EEG findings in subject 1 are shown in Figure 2.

The concentration of HEOD and the symptoms of the 8 men examined two years after exposure to aldrin, 4 of whom were not among the 12 men chosen at random in 1967, are also shown in the Table.

Discussion

In general our findings confirm an earlier report on

TABLE
DURATION OF EXPOSURE, SYMPTOMS, AND CONCENTRATION OF HEOD IN WHOLE BLOOD: 15 + 4 MEN EXPOSED TO ALDRIN IN A MANUFACTURING PLANT UP TO 1967, OF WHOM 8 WERE EXPOSED TO LINDANE IN A MANUFACTURING PLANT FROM 1967 TO 1969

Subject	Age in 1967 (yr)	Total exposure (yr)	1967		1969		Conc. HEOD in whole blood (ppm)	
			Clinical symptoms	EEG	Clinical symptoms	EEG	1967	1969
1	45	3.3	+++ ¹	+++	No exposure		0.3-0.4 ³	—
2	45	3.0	+++ ¹	+++	+	0	0.280	0.020
3	46	4.0	++	+	No exposure		0.276	—
4	33	2.0	+	0	No exposure		0.255	—
5	53	3.0	0	0	No exposure		0.250	—
6	46	5.0	0	+	No exposure		0.209	—
7	37	3.0	++	+	No exposure		0.195	—
8	19	2.0	+++ ¹	+++	No exposure		0.190	—
9	23	4.0	0	+	No exposure		0.190	—
10	39	3.0	0	0	+	0	0.103	0.039
11	34	5.0	0	++	0	+	0.095	0.006
12	41	1.0	0 ²	0	No exposure		0.065	—
13	45	2.0	0	0	No exposure		0.058	—
14	36	2.0	++	+	+	+	0.050	0.014
15	24	1.0	0	0	No exposure		0.024	—
<i>Earlier data</i>								
16	33	3.0	+++ ²	+++	0	0	—	0.023
17	53	4.0	+++ ²	+++	0	0	—	0.020
18	47	3.5	+	++	0	0	—	0.008
19	34	2.0	0	0	0	0	—	0.008

¹History of grand mal attack at time of examination.

²History of grand mal attack in 1966.

³Extrapolated.

FIG. 1. Changes in blood dieldrin-levels and EEG findings, after removal from exposure, in three workers who had the more serious complaints.

FIG. 2. Subject 1. Changes in EEG findings (a) before exposure; (b) on day of 'grand mal' attack; (c) 135 days after removal from exposure; and (d) 180 days after removal from exposure.

the symptoms and concentration of HEOD in whole blood after occupational over-exposure to aldrin (Kazantzis *et al.*, 1964). Examination of the HEOD concentrations in whole blood shows that signs of slight poisoning were present when the concentration was greater than 0.10 ppm, and absent when it was less than 0.05 ppm. However, in some subjects no symptoms were present even when the concentration of HEOD was greater than 0.25 ppm. This might be explained by these individuals being less susceptible. The Table shows that subject 14 still had symptoms and EEG changes with an HEOD concentration of 0.05 ppm.

Three men (subjects 1, 2, and 8), removed from exposure because of epileptiform fits, were followed up for seven months. With the fall of the concentration of HEOD in whole blood, the EEG findings returned to normal (Fig. 1). The clinical symptoms also subsided and ceased. The rate of decrease of the concentration of HEOD in whole blood during this period was in accordance with the observation of Robinson (cited by Brown *et al.*, (1964)), *i.e.*, in man the biological half-life in whole blood was between 50 and 167 days. Nevertheless, our further observations after two years showed that this half-life period was true only until the HEOD concentration reached a certain level. Thereafter its clearance from the blood slowed down considerably and occasionally the half-life was prolonged, even for years. This delayed clearance was not the result of further environmental exposure, as our investigations have shown that practically no HEOD was demonstrable in the blood of the general population of Hungary. This clearance is much slower than that which has been found in animal experiments by Robinson, Roberts, Baldwin, and Walker (1969).

The residual clinical symptoms and EEG changes in 1969 of subjects 2, 10, 11, and 14, who had been exposed to aldrin two years previously, are equivocal, for their symptoms could well be related to occupational exposure to lindane which had been intermittent over these two years. Nevertheless, our

observations on men with minor exposures to lindane showed no positive clinical symptoms or EEG findings, even if two years earlier, during the aldrin exposure, they had exhibited serious symptoms (subjects 16 and 17). Thus over-exposure to aldrin did not induce increased sensitivity to minor doses of lindane (Czeglédi-Jankó and Avar, 1970).

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