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Exposure to fluorocarbons during the filling and repair of air-conditioning systems in cars — A case report

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ÅSTRÖM T, JONSSON A, JÄRVHOLM B. Exposure to fluorocarbons during the filling and repair of air-conditioning systems in cars — A case report. *Scand J Work Environ Health* 13 (1987) 527–528. A worker exposed to fluorocarbons in an automobile plant for seven years experienced shortness of breath (in 1977) and was referred to the hospital. The clinical examination revealed electrocardiographic abnormalities. He recovered quickly and returned to work. During the following year (1978) he suffered subarachnoid bleeding with hemiparesis, and four years later he had an operation for a thymoma. Hygienic measurements in 1980–1981 showed large variations in the fluorocarbon concentrations in the plant, the average 8-h concentrations being below the occupational exposure limit of 500 ppm but several short-time measurements reaching levels of over 750 ppm. It was suggested that, persons with heart disease do not necessarily have to be removed from work with fluorocarbons without careful review of the exposure but that the evaluation of the exposure should not only be based on time-weighted average concentrations, but also on values for brief periods, in that such concentrations can often be decreased by simple and cheap measures.

Key terms: heart disease, occupational exposure.

Fluorocarbons are used in industry for degreasing and in refrigeration systems. Previously they were widely used as propellants in aerosols. Many modern cars have air-conditioning systems taking 1–2 kg of fluorocarbons. During manufacturing and repair, workers are sometimes exposed to rather high peaks of fluorocarbons when they fill or empty these systems or when leakage occurs.

In the present report the exposure levels in one such factory and one case of heart disease possibly associated with this exposure are presented.

The factory in question produces about 20 cars per hour equipped with air-conditioning systems. Empty systems are installed in a car and filled with about 1.3–1.5 kg of fluorocarbons. Such systems have been installed in cars in this factory since the early 1960s. Dichlorodifluoromethane has almost exclusively been used as the refrigerant. The cars are assembled on-line. Until 1980–1982 the air-conditioning systems were filled and checked after the car had left the line. In 1982 the filling was reorganized and done on-line.

Before 1982 the filling and adjustment were done in a room of about 500 m². In 1980–1981 measurements according to a standard method (4) showed large variations in the fluorocarbon concentrations. The average concentrations for an 8-h workday were always below 500 ppm (the Swedish occupational exposure

limit). However, several concentrations over 750 ppm (short-time limit in Sweden) were measured during adjustments (averages during 15 min). Breakage of a valve resulted in concentrations of around 6 000 ppm during the first 15 min and around 2 000 ppm for the next 20 min.

The on-line filling takes 1–2 min/car and is done at the end of the production lines. Some air-conditioning systems (about 1.5 %) have flaws which are not found until the filling and testing. The car is then moved to a special area where the refrigerant is drained.

Even before the practice of on-line filling began, the systems were filled by the regular workforce, which has had considerable turnover throughout the history of the plant. However, adjustments have generally been done by a few men who spend a few days a week adjusting air-conditioning systems.

To decrease the exposure to fluorocarbons, several measures have been undertaken. They have included changes in work organization, information activities, and the introduction of the use of protective equipment. Later, measurements indicated average concentrations of dichlorodifluoromethane of below 20 ppm. There may still be some mistakes and technical faults that cause isolated peak exposures, but they are so rare that the average concentration is well below 20 ppm.

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Case history

One worker, born in 1921, had had different manual jobs with no particular exposure to chemicals up until 1970. In 1970 he started to work in the department

where the air-conditioning systems were adjusted in new cars. He had previously been generally healthy and was a nonsmoker.

In 1977 he experienced shortness of breath. He was referred to a hospital due to dyspnea. On admission he had rales in his lungs, and his chest radiograph showed congestion with pleurisy. An electrocardiogram showed tachycardia with supraventricular extrasystoles and a high frequency of monofocal ventricular extrasystoles. Liver enzymes (aspartate aminotransferase and alanine aminotransferase), taken during 3 d, were all below the reference limits and showed no tendency to increase. Lactate dehydrogenase with isoenzymes and the creatinine kinase concentration were also within the reference limits. The worker was treated with diuretics and was sent home after 5 d. His chest radiograph then showed decreased congestion and a relative cardiac volume of 600 ml/m². He recovered very quickly and could walk four stairs after a few days. He was on sick leave for about a month and then returned to work.

He had a check-up 1.5 months later and had no symptoms. His electrocardiogram showed no arrhythmia, and his chest radiograph showed a relative heart volume of 600 ml/m² and no sign of congestion in the lung parenchyma. Medication was discontinued. Since 1977 he has had no signs of primary heart disease, but in 1978 he had subarachnoid bleeding with hemiparesis. In 1982 he had an operation for a thymoma.

Discussion

Fluorocarbons are in rather widespread use, but we have found no report of human ill health associated with industrial exposure to dichlorodifluoromethane. Svensson et al (5) examined 12 refrigerator repairmen electrocardiographically during work but found no sign of disease.

Animal experiments have revealed ambiguous results. Dogs exposed to 100 000 ppm for 5 min had tachycardia (1), but another experiment showed no cardiopulmonary toxicity in dogs after exposure to up to 800 000 ppm for 5 min (2). Dogs exposed to 100 000 ppm during running did not show any arrhythmia either (3).

The medical history of our case is suggestive of an association with a cardiotoxic agent, but no firm conclusions can be drawn from such an isolated case. Another worker with a shorter employment time in the same department reported heart palpitations during work adjusting air-conditioning systems, but no electrocardiogram was taken. Another man with the same job (38 years of age) had been to the health department due to palpitations, but his electrocardiogram showed no arrhythmia.

The question of whether persons with heart disease should work with fluorocarbons has sometimes been discussed, as such persons might be unduly sensitive to a potential cardiotoxic agent. We do not think that our findings imply that all persons with heart disease should be removed from work with fluorocarbons without a careful review of the exposure. We suggest, however, that the evaluation of the exposure to fluorocarbons in such situations should not be based only on time average concentrations, but also on values for brief periods. Such concentrations can often be greatly decreased by simple and cheap measures based on risk analysis.

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