Vinyl Chloride Cytogenetics

Dante J. Picciano, Ph.D.; Ray E. Flake, M.D.; Peter C. Gay, M.D.; and D. Jack Kilian, M.D.

This report presents cytogenetic findings from a group of 209 workers employed for up to 28 years in the manufacture of vinyl chloride monomer at the Texas Division of Dow Chemical U.S.A. Cytogenetic evaluation results from this group were compared to results found in examination of individuals being considered for employment. Statistical analyses were performed on a group basis for chromatid aberrations, chromosome aberrations and proportion of abnormal cells; no statistical difference of significance was found between the two groups. Comparison of these results with reported studies suggests that the level of cytogenetic aberrations in vinyl chloride workers is probably related to the length and level of exposure, and that risk of adverse genetic effect can be avoided in cohtrolled, minimal-exposure environments.

Vinyl chloride (VC) has been reported to be carcinogenic in animals[1, 2] and human beings[3] and mutagenic in bacterial test systems[4, 5, 6] There have been reports of increased frequencies of chromosomal aberrations in workers exposed to vinyl chloride at polyvinyl chloride (PVC) facilities[7, 8, 9] Similar increases were not found upon cytogenetic evaluation of German PVC workers[10] nor in our own preliminary investigation of a group of American VC workers[11] One study based on interviews with male employees has indicated an increased rate of fetal wastage among wives of VC-exposed workmen involved in polymerization operations[12]

We have recently completed cytogenetic evaluation of all currently-employed workers exposed to vinyl chloride at the Dow (Freeport) Texas Division Both vinyl chloride and vinylidene chloride are produced in this plant Vinylidene chloride has also been reported as mutagenic in bacterial test systems[13] However, while these Dow workers are involved with the production of both compounds, the degree of contact with vinylidene chloride is far less than the exposure to vinyl chloride

From Occupational Health and Medical Research Dow Chemical U.S.A. (Drs. Picciano and Kilian) and Department of Industrial Medicine Dow Chemical U.S.A. Texas Division (Drs. Flake and Gay) Freeport TX 77541

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Vinyl chloride monomer has been produced at the Texas Division of Dow Chemical U.S.A since 1948. There are no vinyl chloride polymerization operations Average exposure levels, as is the case for almost all vinyl chloride monomer plants, have been generally lower than those reported for facilities involved in polymerization operations[14] Although the threshold limit values for vinyl chloride had been 500 parts per million (ppm) until 1974, Dow had established a goal of 50 ppm or below in 1959.[15] The current Occupational Health and Safety Administration (OSHA) standard for vinyl chloride is one ppm as a time-weighted-average over an eight-hour workday. We have found that the TWA concentration of vinyl chloride for all VC-related job classifications was approximately 5 ppm from 1968 to 1973; in 1974, TWA concentrations were 1 to 2 ppm. Since 1975, average levels of exposure have been lowered to less than 1 ppm Estimates of average exposure levels for the years prior to 1968 are less reliable. For the purposes of this study, estimates of exposure were calculated for specific job classifications, based on records of both personnel and area monitoring (Table 1). However, actual exposure may vary from individual to individual within the same job classification and accidental, short-term exposures of some workers to concentrations in excess of the standard probably occur from time to time Documentation of such incidents is difficult

Methods

Our study group was composed of 209 workers who had worked in the vinyl chloride plant for periods ranging between one and 332 months (average, 48.3 months) at the time of this investigation As part of the medical surveillance program for this group, peripheral blood samples were obtained, and evaluation of lymphocyte chromosomes was performed. Lymphocytes were cultured using a modification of the Moorhead technique.[16] Standard procedures, as previously described,[17] were used for incubation, processing, and analysis.

Findings were compared to cytogenetic data from a group of 295 "preemployment examinees" who had chromosome evaluation done as part of routine preemployment examination and who, at that time, had no known exposure to chromosome-break-

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