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Vinyl Chloride Exposure in a Controlled Industrial Environment

A Long-Term Mortality Experience in 594 Employees

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Vinyl chloride has been associated recently with findings of angiosarcoma in animals and man. The present study examines the mortality experience of individuals occupationally exposed to vinyl chloride and lesser amounts of vinylidene chloride and other compounds.

Employees were grouped into four exposure categories according to the highest levels of vinyl chloride exposure experienced for at least one month. Although no angiosarcomas were found and there were no deaths due to any liver malignancy, the observed malignancy deaths exceeded the expected among workers in the high-exposure category. Fewer than expected malignancy deaths were observed in the remaining exposure categories.

Vinyl chloride has a 30- to 40-year history of industrial use. Until recently, it was thought to be a relatively benign material and, in fact, was once considered for use as a surgical anesthetic. Reports documenting anesthetic effects in animals and humans and liver injury in animals from chronic exposure were published in 1960 thru 1963 by Mastromatteo et al,[1] Torkelson et al,[2] and Lester et al.[3]

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A new clinical entity associated with vinyl chloride exposure, acroosteolysis, was reported in the United States by Wilson et al in 1967.[4] This was elaborated by Cook et al,[5] Dodson et al,[6] and Dinman et al.[7]

In 1972, an environmental study of vinyl chloride workers by Kramer and Mutchler[8] revealed laboratory indications of liver disease in workers exposed to a time-weighted average concentration for an eight-hour day (TWA) of 300 ppm or above. [illegible] of other effects associated with exposure to high levels of vinyl chloride were summarized by Marstellar and Juhe[9] in the European literature.

Neoplasia was first associated with vinyl chloride in 1971 by Viola et al.[10] Maltoni[11] later reported malignant changes in animals, including angiosarcoma of the liver. Creech and Johnson[12] supported this observation by their report of angiosarcoma of the liver in vinyl chloride workers. In May 1974, Tabershaw and Gaffey[13] released their industry-wide epidemiological study of vinyl chloride workers that suggested increased numbers of malignant neoplasms at other body sites.

This report summarizes the mortality experience of an industrial population exposed to vinyl chloride in an environment for which many years of monitoring data are available. Many of the employees were also included in the Tabershaw and Gaffey report; however, in the present study the mortality experience was combined with more clearly defined levels of exposure and follow-up of former company employees.

HISTORY

Research involving vinyl chloride started at this company location in the mid-1930s. In 1941, a small copolymer plant was constructed that employed four operators, two miller-packagers, one foreman, and one superintendent. In the late 1940s, the plant capacity was enlarged and two assistant operators joined the work force. The copolymer plant continued to grow and other types of copolymer were developed, which resulted in a larger department with a new group of operating, clerical, and supervisory personnel. A small production unit to produce vinyl chloride monomer and a copolymer semiplant also were operated during this period.

Continued research resulted in a new outdoor homopolymer (PVC) and copolymer unit being constructed in 1952. The rapid development of the market for PVC resin in the 1950s outstripped the new plant capacity. In response, PVC production was begun in a portion of a third copolymer unit that had previously used only limited quantities of vinyl chloride. Thus, besides the research efforts and monomer production, three polymer units were in operation. The PVC was produced until 1969, when the decision was made to discontinue production of homopolymer and use the facilities to modernize copolymer production. The modernization allowed the closing of the plant built in 1941.