Clinical Findings in Workers Exposed to Pentachlorophenol

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Abstract. Comparative findings are presented on the health and exposure status of groups of individuals in Hawaii with and without occupational exposure to pentachlorophenol (PCP). Occupational exposure to PCP occurred through employment at firms engaged in the treatment of wood with either PCP alone or PCP plus other compounds as preservative chemicals. Mean serum levels were 0.32 ppm for 32 control individuals, 1.72 ppm for 24 workers exposed to PCP and other wood preservative chemicals, and 3.78 ppm for 22 workers exposed to PCP as the sole preservative chemical.

Age-standardized prevalence rates were significantly higher among the PCP-exposed than among the controls for low-grade infections or inflammations of the skin and subcutaneous tissue, protective membrane of the eyes and the mucosa membrane of the upper respiratory tract. Strong to moderate statistical associations were observed between PCP exposure and increased occurrence of bands (immature leucocytes) and basophils, increased plasma cholinesterase, alkaline phosphatase, gamma globulin and uric acid, and decreased serum calcium. Despite these statistical associations, laboratory values considered to be clinically abnormal were few and not significantly greater in occurrence among the PCP-exposed individuals.

During the seven year period between 1967 through 1973 a major effort was made to monitor the health of over 400 residents of Hawaii who were in large part occupationally exposed to pesticides. The work was done by the Hawaii Community Studies Project as part of a federally sponsored nationwide program of research initiated in 1965 by the U.S. Public Health Service to determine whether exposure to pesticides at home or at work was injurious to health (Acosta 1965).

Research supported through a contract with the Epidemiologic Studies Program, Human Effects Monitoring Branch, Technical Services Division of the U.S. Environmental Protection Agency, Washington, DC 20460, and a grant from the American Wood Preservers' Institute, 1651 Old Meadows Road, McClean, VA 22101.
The volunteer participants of the Hawaii study were given extensive annual medical examinations which included a battery of biochemical, organ function, and behavioral tests. Comparative data on pesticide exposure were collected subjectively through information on worker contact with pesticides and objectively by repeated measurements of concentrations of organochlorine pesticides (including PCP) in blood samples collected from the participants. Concentrations of PCP also were determined in urine samples.

The large volume of data on this study has undergone processing and a number of the findings have been published (Klemmer 1971, Rayner et al. 1972, Takahashi et al. 1976, Rashad et al. 1976, Begley et al. 1977, Budy et al. 1977, Korsak and Sato 1977). Comparative findings are reported herein on groups of workers with and without occupational exposure to PCP. This publication has been preceded by a final report (Sato et al. 1978) issued to the Human Effects Monitoring Branch, U.S. Environmental Protection Agency and to the American Wood Preservers’ Institute.

Clinical and Laboratory Methods

Physical examinations were conducted either by project physicians or by staff at local clinics and were given annually to all participants who elected to remain in the study for more than one year. Blood chemistry and urinalysis testing was done at the project laboratory or at local clinical laboratories by methods approved by the sponsoring agency (Smith 1969) and in conformity with a federally supervised quality control program. Pesticide residue analyses were done at the project laboratory by methods prescribed by the sponsoring agency (Burchfield et al. 1965, Thompson 1974). Earlier research done by the Hawaii project had led to the development of a sensitive method for the measurement of PCP in human urine (Bevenue et al. 1966, Bevenue et al. 1967a, 1967b). This, as well as the later development of a method for the measurement of PCP in blood (Bevenue, et al. 1968; Casarett et al. 1969), provided the Hawaii project with the analytical skill and the interest to recruit into the present study a number of workers with occupational exposure to PCP.

Characteristics of the Study Sample

The total sample size consisted of 422 individuals. Only the last set of data collected on each individual was used for the present evaluation. Within the total sample, 42 individuals were controls with no occupational exposure, 333 were farmers or pest control operators (PCOs) with mixed exposure to various pesticides, and 47 were employees of firms that processed lumber and other wood products by treatment with PCP and other wood preservative chemicals (hereinafter referred to as the wood-treatment group).

The wood-treatment group of workers obtained exposure to PCP through two different processes for the preservative treatment of wood (Casarett et al. 1969). One process involved the open vat dipping of wood products in a kerosene solution containing approximately 5% PCP and sometimes antibloom agents other than kerosene. Workers undergoing the greatest exposure in this process were those engaged in the filling and periodic cleaning of the vat, the fork lift operators, and those who otherwise came in direct contact with either the chemical solution or the treated wood. Twenty-one of the workers in the wood-treatment group were employed in this type of treatment process which used PCP exclusively as the preservative chemical. The second wood treatment process involved pressure treatment of wood products with mixtures of different formulations which contained PCP salts or acids of chromium, fluorine, arsenic, copper, boron, tin, and dieldrin. The greatest worker exposure by this process occurred through inhalation of fumes upon the opening of the retort, from tank cleaning operations, from contact with spilled formulations, and/or direct contact with the treated wood. Twenty-six of the workers in the wood-treatment group were employed in this type of treatment process and thus obtained a mixed exposure to PCP and other preservative chemicals.