Epidemiologic Study Of Chromate Production Workers: A Summary

Editor's Note: *The following is a summary of a presentation given January 25 in Orlando, FL, at the AESF/EPA Conference for Environmental Excellence by Dr. Herman J. Gibb, National Center for Environmental Assessment, U.S. EPA, Washington, DC. Dr. Gibb's coauthors included Peter Lees and Brian Rooney, School of Hygiene & Public Health, Johns Hopkins University, Baltimore, MD, and Paul Pinsky, National Cancer Institute, Bethesda, MD.*

Introduction

To date, the study that has provided the most information on the lung cancer exposure response to chromium has been the mortality study by Mancuso (1975) of a cohort of chromate production workers at a plant in Painesville, OH. This study was updated in 1997. A current mortality study (jointly conducted by the Johns Hopkins University and the U.S. EPA) of chromate production workers at a plant in Baltimore, MD, offers several advantages over the Mancuso study for exposure response assessment, including a larger cohort, more person-years of observation, industrial hygiene measurements concurrent with the work histories, ambient measurements of hexavalent chromium and smoking histories for 93 percent of the cohort.

A clear dose response to cumulative hexavalent chromium was observed in the current study and was a much stronger factor than either cumulative trivalent chromium exposure or duration of work. The lung cancer exposure response to cumulative hexavalent chromium was significant, even when smoking was included as a variable. Chromium is an irritating substance as evidenced by the number of nasal, skin, eye and ear problems experienced by the cohort.

Study Data

In comparison to the Mancuso study, the current study had several advantages. Mancuso had 332 white males, whereas the Gibb study had 2,357 total (almost half white and half nonwhite). Mancuso's industrial hygiene data were taken at a later date (1949) and applied to workers employed between 1931 and 1937, whereas the Gibb study had exposure information that was current with the work history.

Mancuso had ambient information for total chromium; the Gibb study had ambient information for hexavalent chromium, which was of particular interest. The number of lung cancer deaths in Mancuso's study was 41 (updated in 1997 to 66) vs. 122 lung cancer deaths in the Gibb study. There was also considerably more person-years of observation (years at-risk) in the Gibb study, and it included smoking data for 93 percent of the cohort. Mancuso had no smoking data. Within the current cohort, 82 percent smoked cigarettes and 18 percent did not.

The data showed that, for all causes of death—including heart disease and all cancers—the mortality rate was about the same as for the general population. Respiratory cancer and lung cancer, however, were statistically significant.

Results & Conclusions

The results were compiled and put into a proportional hazards model that looked at the time from exposure, going out, for cumulative hexavalent chromium exposure with cigarette smoking, and for trivalent chromium and smoking. The trivalent data came from a study of settled dust in the plant, which was analyzed for the ratio of hexavalent to trivalent chromium in the dust. After putting the data into the model, together with the smoking data, results showed that cumulative hexavalent chromium was statistically significant, but cumulative trivalent was not significant (additional studies would be necessary to determine carcinogenic risk from trivalent chromium at this plant).

For symptoms of irritation, as reported by workers to the plant dispensary, 68 percent of the cohort reported irritated nasal septum, and 63 percent reported ulcerated nasal septum. These symptoms are considered "hallmark" lesions of chromium exposure that have been reported in many other studies of chromate workers. It is considered significant that between 60 and 70 percent of this cohort experienced these two symptoms. It must also be noted that, in addition to ambient exposure, personal hygiene plays a part in such symptoms. Dermal contact—such as workers touching their faces, eyes, ears or noses with their hands—would be a contributing factor.

Cumulative hexavalent chromium exposure, therefore, appears to be the best predictor of lung cancer risk in the current study. The results with respect to trivalent chromium, however, are inconclusive. The irritation symptoms found are considered sentinel; however, with respect to lung cancer risk, irritation symptoms should not be the sole indicator of a potential health problem. P&SF

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