SESSION III - EPIDEMIOLOGY OF LEAD

EPIDEMIOLOGY OF LEAD EXPOSURE AMONG OCCUPATIONAL GROUPS

Dr. Kenneth Bridbord, Moderator
Environmental Protection Agency

A B S T R A C T

The epidemiology studies presented in the 1972 NIOSH Criteria Document on Inorganic Lead are briefly reviewed. The most consistent long term effects of lead presented in these studies involve renal damage. A recent mortality study of workers exposed to lead in smelters and battery plants also provides evidence of kidney damage caused by lead. Other chronic effects of lead suggested include carcinogenic effects involving the digestive and respiratory systems and hypertensive diseases. Areas of future research needs include chronic effects due to lead, effects of lead upon fetal development, and interactions between lead and other chemicals.

I would like to very briefly review some of what we know from the literature with respect to the epidemiology of lead in occupational situations and then give each of the panelists a chance to present some important new information. In general, while our knowledge of the acute effects of lead is reasonably good, we cannot say that what is known about the chronic effects of lead is equally as good. Some of the reasons why relatively little is known about the chronic effects of lead relate to problems with respect to the basic strengths and weaknesses of epidemiologic studies. Briefly, among the strengths, epidemiologic studies deal with observations in man and natural exposures from which information on long-term, low-level effects can sometimes be obtained; among the weaknesses are problems quantifying exposure, the fact that there usually are many covariants present which are difficult to control, and the whole question of separating associations from causations.

I would like to very briefly consider chronic health studies, the epidemiology studies that were reviewed in the NIOSH Criteria Document. Lane[1] observed that lead storage battery workers had an excess mortality compared to the general population. This was primarily attributable to vascular lesions in the central nervous system. Dressen *et al*[2] observed, in 1941, that the incidence of arteriosclerotic hypertensive disease was not increased in workers exposed to high levels of lead as compared to a low-level lead exposure group. Dingwall-Fordyce and Lane,[3] in 1963 observed an excess of death attributable to cerebrovascular accidents in a high lead exposure group, compared to the general population.

No consistent association was found between malignant disease and

lead absorption. It is notable that there was no dose-response relationship in this case but in this particular study there was slight indication of an excess in cancer rate among workers with low lead exposure. Malcomb,[4] in 1971, observed no occupationally induced hypertension and no increased frequency of cerebrovascular disease deaths in lead exposed workers when compared to the general population.

Henderson and Inglis,[5] in 1957, observed chronic nephritis related to excess lead absorption, based upon lead levels in bone. Lane,[6] in 1949, observed death from renal failure in men exposed for long periods to high concentrations of lead.

In summary, there is at least some suggestive evidence of adverse health effects related to long term chronic lead exposures, based on the studies in the NIOSH Criteria Document. Certainly conclusive evidence is not available, except perhaps for the somewhat consistent findings of renal disease in workers exposed for long periods to lead.

I tried to review the recent literature; however, I may have missed important studies. Two studies relating to chronic lead health effects were reviewed. One study was carried out by Dr. Theodore Robinson, who is on our panel, and the other is the Tabershaw Cooper Study, by Cooper and Gaffey in 1974. Robinson[7], in 1974, observed that TEL and non-TEL workers do not experience a reduced life expectancy compared to the general population. In reviewing this particular paper, I was struck by what appeared to be a 50 percent excess of total cancer deaths among older TEL workers compared to non-TEL workers and suggest that this may deserve further follow-up, particularly with respect to the results of the Cooper and Gaffey study.[8] Cooper and Gaffey found the SMR for all malignant neoplasma was 133 for smelter workers and 111 for battery plant employees; but again, no association was found between cancer and duration of employment.

Most excess cancer involved the digestive and respiratory systems. It is important to note, and I believe it was referred to this morning, that SMR's in smelter and battery plant workers, respectively for other hypertensive disease were 389 and 223, and for chronic and unspecified nephritis 264 and 175. The SMR's for all causes in both worker groups were 107 and 99. I believe this may suggest a poorer health experience compared with other working populations. Again I stress, *compared to other working populations*.

Before closing, I would like to identify a few areas that may merit some further exploration. As mentioned before, certainly the need for additional studies of possible long term chronic effects due to lead would fall into this category. One is concerned about the possibility of life shortening effects of lead, particularly through kidney damage and carcinogenic effects of lead which also should be in this same category. I would add that, if lead were a carcinogen, it would have to be a very

weak one. However, there certainly is some evidence in toxicology that it may act, at least in certain circumstances, as a co-carcinogen. Certainly the significance of interference in porphyrin metabolism is very important, and the inhibition of the metabolism in other tissues besides the mature red blood cell should be investigated. A good example of such inhibition that may be important is lead related interference in porphyrin metabolism in the liver.

Effects of lead on children of workers is also important. I hope Dr. Landrigan will refer to this both with respect to children in communities near lead stationary sources and children of the workers. Susceptibility of the female workers is also an unresolved issue and one that I hope will elicit some further study among members of the audience.

Finally, the whole question of interactions is extremely important. We tend to forget that exposures to chemicals are combined. One lead interaction that may be important to study is lead and benzo(a)pyrene. Kobayashi[9] found an interaction between lead oxide and benzo(a)pyrene in Syrian hamsters, I believe, with respect to causing lung cancer. The whole question of interactions between lead, arsenic and cadmium may be extremely important, particularly with respect to smelter workers. I suggest the questions of lead interacting with organic solvents may be another area for study, particularly since some of the organic solvents also interfere with porphyrin metabolism pathways.

Lead and tritium is a final example. In EPA laboratories in North Carolina, we have observed that lead and tritium may interact in causing behavioral effects in animals. I would like now to give the panel members a chance to give their presentations. For future reference, after our session is completed, will anyone asking questions, please state their names before presenting questions. It will be very much appreciated.

REFERENCES

1. Lane, R. E., Health control in inorganic lead industries--a follow-up of exposed workers, Arch Environ Hlth 8:243-50, 1964

2. Dressen, W.C., Edwards, T.I., Reinhart, W.H., Page, R.T., Webster, S.H., Armstrong, D.W., Sayers, R.R., The control of the lead hazard in the storage battery industry, PH Bull. 262. Federal Securing Agcy. U.S. PHS, Govt. Prntg Off, 1941

3. Dingwall-Fordyce, I., Lane, R.E., A follow-up study of lead workers, Br J Ind Med 20:313-15, 1963

4. Malcolm, D., Prevention of long-term sequelae following the absorption of lead, Arch Environ Hlth 23:292-98, 1971

5. Henderson, D.A., Inglis, J.A., The lead content of bone in chronic Bright's disease, Australasian Ann Med 6:145--4, 1957

6. Lane, R. E., The care of the lead worker, Br J Ind Med 6:125-63, 1949

7. Robinson, J.R., Twenty-year mortality of tetraethyl lead workers, J Occ Med 16:601-605, Sept. 1974

8. Cooper, W.C., and Gaffey, W.R., Mortality of workers in lead smelters and lead battery plants, J Occ Med 17:100-7, Feb, 1975

9. Kobayashi, N., and Okamoto, T., Effects of lead oxide in the induction of lung tumors in Syrian hamsters, J Nat Can Inst 52:1605-8, May, 1974

MODERATOR-Dr. Kenneth Bridbord

The first speaker in this session will be Dr. Theodore Robinson, Plant Medical Director for the Ethyl Corporation. Dr. Robinson will discuss Health, How Can It Be Measured? Dr. Robinson

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

HEALTH EFFECTS OF *OCCUPATIONAL LEAD and ARSENIC EXPOSURE* A SYMPOSIUM

HEALTH EFFECTS OF OCCUPATIONAL LEAD AND ARSENIC EXPOSURE

A SYMPOSIUM

Edited By

Bertram W. Carnow, M.D.
University of Illinois School of Public Health
Contract Number 210-75-0026

Chicago, Illinois
February 24-25, 1975

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health
Division of Surveillance, Hazard Evaluations and Field Studies

February 1976

For sale by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402

SPONSORED BY: Society for Occupational and Environmental Health
National Institute for Occupational Safety and Health
United Church Board of Homeland Ministries
University of Illinois School of Public Health
Chicago Lung Association

SUPPORTED BY: National Institute for Occupational Safety and Health
United Church Board of Homeland Ministries

PLANNING COMMITTEE:

Bertram W. Carnow, Chairman
Edward J. Calabrese
Richard A. Lemen
Vaun A. Newill
John Zalusky

HEW PUBLICATION NO. (NIOSH) 76-134

The Editor or his staff prepared abstracts of the presentation when they did not accompany the author's manuscript.