A STUDY OF THE LEAD HAZARDS ASSOCIATED WITH THE REPAIR OF GASOLINE DISPENSING PUMPS

By

L. W. Sanders, M. D.

From the Kettering Laboratory of Applied Physiology,
College of Medicine, University of Cincinnati

The following observations make up part of a general program for the study of the potential hazards associated with the distribution and use of motor fuels containing tetraethyl lead. The specific problem was to determine the extent of the lead exposure associated with current procedure for cleaning, repairing and re-assembling gasoline dispensing pumps.

Preliminary enquiry demonstrated at once that there was no one site at which this problem could be studied; that the persons engaged in this work were few in number and widely scattered; and that current practice with respect to repair and the disposition of pumps to be repaired was highly variable. Further investigation demonstrated that the major oil companies in servicing their own pumps, did most of this work. Despite this fact, it was rarely necessary for any of these companies, even in the larger cities, to employ more than two men at major repair work in a shop. The greater part, by far, of all pump repair work consisted of minor repairs made at the pump site in the open air, and usually when the pump was wet with gasoline.

An effort was made to find those workmen who had been exposed most severely and for the longest period of time to dried gasoline residues, (and incidentally to dried litharge pastes with which most pumps are sealed). Obviously, the best group for such a purpose would be composed only of men working full time on dry parts, in unventilated shops. However, of the 34 men distributed over an area stretching from New York to St. Louis, who were eventually chosen for study, only 17 satisfied these requirements. The remaining 17 employed methods which reduced their opportunities for lead exposure to some degree, or spent some part of their working time in the open air or on an entirely different job. By reason of the care taken to examine into the numerous and varied means for handling work of this type, it is believed that the group, although small is adequate to represent the conditions of exposure.

Each subject was given a complete physical examination with especial

attention paid to history of past lead exposure, to evidences of upper respiratory and conjunctival irritation on his immediate job, and to specific symptoms and signs of lead absorption. Hemoglobin determinations were made with a Dare instrument and blood films were made for stippled cell counts, to be carried out later in the laboratory. The urine was tested for its reaction and for the presence of albumin and sugar. Especial attention was given to the collection of blood and urine samples in such a way as to avoid their contamination. The samples were returned to the laboratory for analysis. Lead determinations on the urine were made by a spectrographic method developed by Cholak (1). Blood samples were split at the time of collection and were analyzed both by the above spectrographic method, and by a dithizone method described by Hubbard (2), with certain modifications introduced by Bambach (3).

Results

The clinical study of individual workmen was negative with respect to evidences of lead poisoning or lead absorption. Moreover, when the items of clinical data for all the men were assembled, the symptomatic and physical deviations from the normal were insignificant in number and type, and were not suggestive of the effects of occupational lead exposure.

Since the decomposition products of tetraethyl lead regularly produce irritation of the nasal mucous membranes, as evidenced particularly by sneezing, all subjects were questioned specifically as to this symptom. Leading questions brought out the fact that practically every man had experienced this symptom in varying degrees of intensity and in widely varying time frequency. One of the older men who had worked on pumps for many years volunteered the information that he felt sure sneezing had occurred to an equal or perhaps even greater extent in repairing the older type of visible pumps and before the introduction of leaded gasoline, than with the newer pumps and since the introduction of leaded gasoline. He attributed this difference to heavier residues on the parts of visible pumps and to differences

between the older and the more modern base stocks used in blending marketable gasolines. In view of the reported experiences of these men, it is thought that this almost constant symptom is of little importance as evidence of lead absorption. It does indicate that better working conditions could be established in some shops with respect to the dissemination of dusts. In some instances the dust could be controlled satisfactorily by the exercise of reasonable care and judgement by the men in the performance of their work.

In the absence of clinical evidence of lead absorption or intoxication, resort was had to detailed study of certain data gained from laboratory observations, as the only means of determining the degree, if any, of the occupational lead exposure of these men. Stippling of the erythrocytes is known to show variation among groups of persons according to the extent of their lead exposure, and the hemoglobin of the blood may also show appreciable diminution in lead workers without other evidences, necessarily, of toxic effects. More specific and sensitive means of detecting lead absorption are found in determinations of the lead content of the urine and the blood. The results of the hemoglobin determinations and of the analyses on the urine and blood were examined by statistical methods.

The observations on stippling of the erythorcytes and on the hemoglobin need only the briefest mention, since all of these results were within the limits observed in normal persons with no occupational lead exposure. The highest count of stippled erythrocytes was 320 per million, which is well within the normal range (4). The lowest hemoglobin percentage was 82, the mean value of the results being 94 ± 0.5 percent. The frequencies of occurence of the findings on the hemoglobin together with the mean value, the probable error of the mean and the standard deviation are shown in Table 1.

The data on the urine are grouped in Table 2. The mean lead content of the urine was found to be 0.074 ± 0.003 mg. per liter. The distribution of the frequencies and the small range of variability of the results are such as to

indicate that the sampling was adequate despite the wide geographic distribution of the subjects. It may be concluded, therefore, that the range of severity of the lead absorption associated with work of this type is adequately portrayed. It is apparent that some degree of occupational lead exposure and absorption occurred among these men, if these results are compared with those obtained on normal persons with no occupational lead exposure. The frequencies for the latter range from 0.01 to 0.08 mg. per liter for comparable samples of urine, with a mean value of 0.03 $\pm$ 0.002 mg. per liter. Likewise, by comparison with the results of observation on groups of persons with various types and degrees of industrial lead exposure, it can be recognized that the lead expsoure associated with the occupation under study is not sufficient to be hazardous. The range of values found in the urine of workmen employed for years under conditions of lead exposure that fall just short of causing toxic effects has been found to be from 0.04 to 0.22 mg. per liter, with a mean of 0.097 $\pm$ 0.004 mg. per liter (5). Groups of workmen with excretory values consistently below this range have uniformly been found to remain free of lead intoxication. One group, that included a number of persons with continuous employment for more than ten years in soldering operations within a building, gave results slightly above these for the pump repairmen. No cases of lead poisoning had occurred among the solderers, and detailed examinations failed to reveal any evidences of toxic effects among them.

The analytical results on the blood are listed, in accordance with the frequencies of their occurence, in Table 3. The mean value of 0.041 $\pm$ 0.001 is slightly above that observed in normal persons and is corroborative evidence of a slight increase in the lead absorption of the men engaged in pump repair. The results here correspond to those found in other group studies, in that the elevation of the lead concentration of the blood above the normal lead is less proportionately than that of the urine. None of the blood values is within the range associated with the occurrence of lead intoxication. The analytical findings as a whole are

characteristic of those observed among lead workers whose occupational exposure has been found to be within safe limits (5).

Conclusions

The lead exposure associated with the regular occupation of cleaning and repairing gasoline dispensing pumps, is too slight to be hazardous, under the conditions prevailing in work of this type.

Such remote possibility of lead intoxication as may exist in the pursuance of this work, could be realized only under conditions representing a very rare combination of circumstances.

This possibility does not warrant the institution of mandatory regulations to avoid lead absorption, but as some moderate increase in lead absorption has been demonstrated, it is desirable that the ordinary precautions observed in the dusty trades be encouraged.

References

1. Cholak, J., and Story, R. V.; Ind. Eng. Chem. Anal. Ed., 10:619 (1938)

2. Hubbard, D. M.; Ind. Eng. Chem. Anal. Ed., 9:493, (1937)

3. Bambach, K.; Ind. Eng. Chem. Anal. Ed., 11:400, (1939)

4. Kehoe, R.A.; Journal of Med. (Cincinnati) 16:527, (1935)

5. Kehoe, R.A.; Report of Industrial Hygiene Sessions; 15th Annual Convention, National Battery Manufacturers Association, part II p. 51 (1939)