NATIONAL INSTITUTE OF ARTHRITIS AND METABOLIC DISEASES

Pope A. Lawrence

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Victor E. Archer

Analysis of samples for Pb 210

After spending considerable time in developing a method, we have analyzed the nine water and urine specimens which you have submitted. We modified the dithizone lead determination method so that the separated lead is deposited on a glass planchet and counted in a gas flow proportional counter. We ran enough controls and a spiked sample to convince ourselves of the validity of the method. The spiked sample showed 86% recovery. We plan to run some more spiked samples and publish the method.

For a reliable count, one should have at least twice the background which in this case is approximately 50 cpm. If a 24 hr. urine sample were concentrated and analyzed, it should contain at least 100 dpm (50% geometry). This would be equivalent to $5.9 \times 10^{-13}$ gram of Pb 210. This would represent the lead formed by the decay of 0.09 microcuries of radon.

Results of analyses:

| Sample name 100 ml analyzed | cpm | Estimated values: $\mu c \times 10^{-4}$ 24 hr. urine | Estimated values: $\mu c \times 10^{-4}$ Daily absorption |
|---|---|---|---|
| Water (1) | 61.4 | | |
| Water (2) | Bkgd. | | |
| Water (3) | Bkgd. | | |
| P. Lawrence | 12.2 | 2.0 | Calculations not applicable |
| O. Ponder | 33.1 | 5.4 | 16.2 |
| J. Johnson | 14.6 | 2.4 | 7.2 |
| H. Hilpert | 27.4 | 4.5 | 13.5 |
| J. Orbene | Bkgd. | | |
| Distilled $H_2O$ | Bkgd. | | |

The estimated 24 hr. urine content was obtained by dividing by 100, multiplying by 1800 (1800 ml. taken as average 24 hr. urine output), multiplying by 2 (geometry of counter), and dividing by $2.2 \times 10^6$ (conversion to microcuries).

The estimate of amount in body is based on the following information supplied by Dr. R. A. Kehoe (data obtained from one normal individual exposed daily to finely divided lead oxide for two years): An equilibrium, with respect to the maximum concentration of lead in the blood and the maxium rate of lead excretion in the urine, was reached in approximately six months, after which the subject went along on a plateau for the rest of the period. In the two years, the subject absorbed approximately 50 mg. of lead (0.0685 mg/da), he excreted approximately 30 mg. (0.0411 mg/da) of which 0.023 mg/da was in the urine.

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Dr. Kehoe's work was done with stable lead, but Pb 210 should behave exactly the same since there is enough stable lead present in the body to act as a carrier.

Using the above figures, at equilibrium (6 mo. or more of exposure) 40% of absorbed lead is retained and 60% is excreted per day. Of that excreted, 56% is in the urine. The urine excretion then represents one third of the daily intake. The amount of daily absorption of lead is thus approximately three times the amount found in the urine.

To make an estimate of the amount of lead 210 in the body of an individual exposed for over six months, one could take 40% (proportion retained) of the amount absorbed daily and multiply by the total number of days exposed.

Assuming that one third of the lead 210 formed by radon decay in the body is excreted in the urine, then the lower limits of the method would be the amount of lead 210 formed by the absorption and decay between 0.2 and 0.3 microcuries of radon per day in chronic exposures. For acute exposures, the lower limit would probably be several times higher because of less excretion.

I am sure that you understand the tentative and preliminary nature of this data and calculations. The analyses were performed on small samples (100 ml.), most of the counts were less than twice background so that the statistical error in counting was large, the data of Kehoe's was obtained from only one individual, the lead in his experiment was administered by a possibly different route, and the chemical form was probably different.