CORRELATION BETWEEN CONCENTRATIONS OF ^{210}Pb IN THE BIOLOGIC SAMPLES FROM MINERS AND INDIVIDUAL LEVELS OF EXPOSURE TO SHORT LIVED RADON-222 DAUGHTER PRODUCTS

Hana I.M. Weissbuch, Mihail D. Grădinaru and Georgeta Th. Mihail

Occupational Medicine Laboratory, Institute of Hygiene and Public Health, Jassy, Romania.

The ^{210}Pb - ^{210}Po skeletal burden may be correlated with specific activities of these elements in biological samples, especially blood and hair levels (1,3). There exists thus the possibility to state some quantitative relations between these parameters and the exposure to inhaled radon daughters, the dose delivered to the bronchial tissue as well as the expected respiratory cancer among miners (4,6).

Compared to radiation exposures evaluated from short lived radon daughters content of mine air, the skeletal levels of lead-210 represents a potentially more accurate measure of miners' exposure. By determining the skeletal reservoir of lead-210 it becomes possible to evaluate the individual cumulated exposures and to make some estimates of prior mine exposures.

MATERIALS AND METHODS

The epidemiological investigation performed by the authors was based on the methodological principle of estimating the miners' exposure both by determining the mine air contamination and the lead-210 blood levels.

As it was expected that cumulated exposure would be estimated from skeletal lead-210, only when steady-state equilibrium was attained between lead-210 bone content in the body fluids, the investigation was carried out only on men who had been exposed over periods of 10 years or more, when miners may be considered to be close to equilibrium (9/10), (2).

The study group included eighty miners and as controls forty adult males, living in the same residence aria as the miners but never being exposed occupationaly to radon daughters.

From the wet-ashed blood samples both ^{210}Bi and ^{210}Po were quantitatively plated on disks. The recovery yield was typically 95 - 8%. The activity of the electroplated elements has been measured by quantitative autoradiography of tracks, using I.F.A.-E.N.1 nuclear emulsion.

The basical hypothesis adopted in the calculation considered that the power function relationship is a statistical property of any biologic sufficiently complex system that has evolved to a state of dynamic equilibrium (7). It is accepted that this kind of mathematical relation characterizes the different biochemical and metabolic mechanisms that involve lead-210 between the actual exposure and the time of sampling (4).

As the power function will be valid only if all lead-210 activity reaching the skeleton is supplied by inhaled radon daughters, the lead-210 body burden originating from other sources was evaluated and suitable corrections had been made (5).

Both $\overline{WL}$ values calculated from blood ^{210}Pb (4) and data about exposure conditions obtained from occupational histories were utilised in estimating individual cumulated exposures (CWLM).

Simultaneously with the bioassay study, working levels (WL) were determined by dynamic determinations of radon daughter concentrations in the mines, where the investigated group had been working.

For a more accurate quantification of the risk the equilibrium grade between Ra A:Ra B:Ra C, the free atoms fraction and the granulometric distribution of aerosols have been considered.

Rolle's modified method (8) was utilised for routine control of the risk factors in the underground work places with noxious radioactivity.

RESULTS AND DISCUSSION

Pair values of the individual exposures resulted from radon decay products inhalation determined by the two methods are plotted in figure 1.

The good agreement between the WLM values obtained from excess lead-210 in bone and those derived from direct measurements of radon daughters in the mine atmosphere emphasizes that the skeletal reservoir of lead-210 may be an extent of the individual exposure to short lived radon daughter products and that the miner's organism behaves as its own dosemeter.

The WLM values resulting from the biological assay are in most cases higher, revealing more important exposures prior to our making the determinations. It may be due either to increased radon emanations or to worse work conditions.

It must be noted that the two value series are not completely independent of each other, as both resort to the occupational histories of miners.

On the whole it may be concluded that the cumulated exposure estimated from the lead-210 body burden expresses more accurately the actual risk, as it is an individual indicator that takes into account the feature

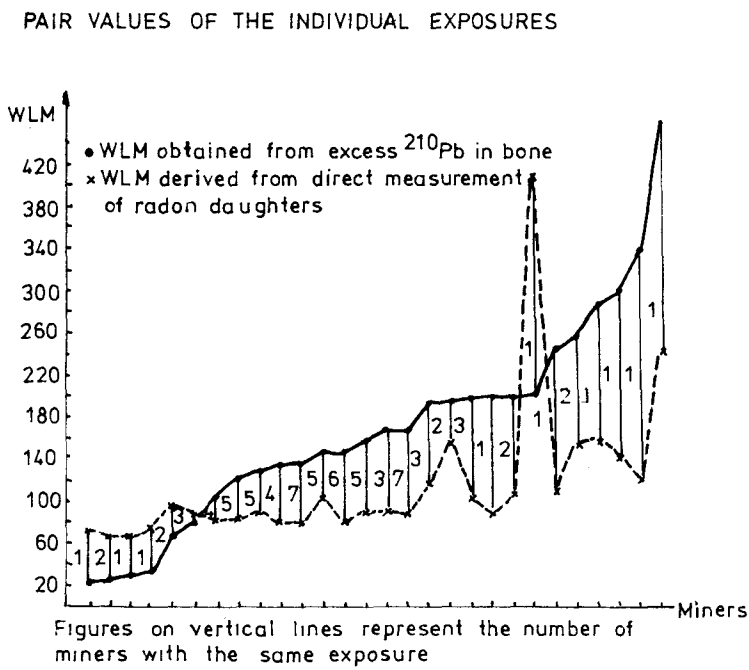

Figure 1

of the organism, the specific of the worker's profession and integrates the aleatory changes in radon daughter concentrations in both their temporal and work place dynamics.

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