**Long-term Retention of Plutonium in the Respiratory Tracts of Two Acutely-exposed Workers: Estimation of Bound Fraction**

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Inhalation of plutonium is a significant contributor of occupational doses in plutonium production, nuclear fuel reprocessing, and cleanup operations. Accurate assessment of the residence time of plutonium in the lungs is important to properly characterize dose and, consequently, the risk from inhalation of plutonium aerosols. This paper discusses the long-term retention of plutonium in different parts of the respiratory tract of two workers who donated their bodies to the US Transuranium and Uranium Registries. The post-mortem tissue radiochemical analysis results, along with the urine bioassay data, were interpreted using Markov Chain Monte Carlo and the latest biokinetic models presented in the Occupational Intakes of Radionuclides series of ICRP publications. The materials inhaled by both workers were found to have solubility between that of plutonium nitrates and oxides. The long-term solubility was also confirmed by comparison of the activity concentration in the lungs and the thoracic lymph nodes. The data from the two individuals can be explained by assuming a bound fraction (fraction of plutonium deposited in the respiratory tract that becomes bound to lung tissue after dissolution) of 1% and 4%, respectively, without having to significantly alter the particle clearance parameters. Effects of different assumptions about the bound fraction on radiation doses to different target regions was also investigated. For inhalation of soluble materials, an assumption of $f_b$ of 1%, compared to the ICRP default of 0.2%, increases the dose to the most sensitive target region of the respiratory tract by 258% and that to the total lung by 116%. Some possible alternate methods of explaining higher-than-expected long-term retention of plutonium in the upper respiratory tract of these individuals—such as physical sequestration of material into the scar tissues and possible uptake by lungs—are also briefly discussed.

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