Modeling the Long-Term Retention of Plutonium in the Human Respiratory Tract Using Scar-Tissue Compartments.

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The respiratory tract tissues of four former nuclear workers with plutonium intakes were radiochemically analyzed post mortem by the United States Transuranium and Uranium Registries. Plutonium activities in the upper respiratory tract of these individuals were found to be higher than those predicted using the most recent biokinetic models described in publications of the International Commission on Radiological Protection. Modification of the model parameters, including the bound fraction, was not able to explain the data in one of the four individuals who had inhaled insoluble form of plutonium. Literature review points to the presence of-and a significant retention of-plutonium in the scar tissues of the lungs. Accordingly, an alternate model with scar-tissue compartments corresponding to larynx, bronchi, bronchioles, alveolar-interstitium and thoracic lymph nodes was proposed. The rates of transfer to the scar tissue compartments were determined using Markov Chain Monte Carlo analysis of data on urinary excretion, lung counts and post-mortem measurements of liver, skeleton and individual respiratory tract compartments, as available. The posterior models predicted that 20-100%-depending on the solubility of the material inhaled-of the activities retained in the respiratory tract were sequestered in the scar tissues.

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