

New Compartmental Model for Plutonium Decorporation Therapy

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Individuals with a significant internal deposition of plutonium typically undergo medical treatment with chelating agents that form stable complexes with plutonium and accelerate its removal from the body. The trisodium salt of calcium diethylenetriaminepentaacetate (Ca-DTPA) is commonly used as a decorporation drug. Since plutonium biokinetics is strongly affected by complexation with the chelating agent, standard biokinetic models cannot be used directly to estimate the intake and radiation dose. A new 5-compartment model for plutonium decorporation therapy was developed using the Coordinated Network for Radiation Dosimetry (CONRAD) approach, which describes the kinetics of the in vivo chelation process. New assumptions and parameters were proposed to account for both the intravenously injected Ca-DTPA and the in vivo formed Pu-DTPA chelate. Modeling was performed using SAAM II® software. For model development, parameterization, and validation, data from a USTUR whole-body donor (Case 0212) were used. This individual had plutonium intake due to a contaminated puncture wound and underwent extensive treatment with Ca-DTPA. For model development, urine bioassay data were used. Post-mortem plutonium activities in the liver and the skeleton were used for the initial model validation. The proposed model more accurately describes urinary excretion and long-term retention of plutonium in tissues, when compared to the original CONRAD model.

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