Critical Evaluation of (Pu-239)O_2 Wound and Lymph Node Retention Predicted by NCRP 156's Recommended Biokinetic Transfer Rates

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A Powerbasic (PBCC 4.03) code has been developed to implement explicitly the general structure of the NCRP Publication 156 recycling biokinetic wound model, which partitions accidentally injected material into four characteristic initial states: (1)fragment, (2)particles, aggregates & bound state, (3) colloid & intermediate state, and; (4) soluble. This was bench-marked (quality assured) against compartmental retention values calculated separately for each of the four possible material states for Pu-239 (as a function of time after intake) by several European institutions, The new code also implements simultaneously the ICRP Publication 67 systemic biokinetic model for plutonium, to calculate the daily excretion of plutonium in urine as a function of time resulting from the combined blood uptake kinetics (from the wound) and that of plutonium subsequently transferred to body organs. The utility of the NCRP wound model structure (and recommended inter-compartmental transfer rates) for predicting the wound and axillary lymph node retention measured for USTUR Case 0262 was examined. This worker died 33 y after receiving an accidental finger-puncture wound contaminated with (Pu-239)O2 particles and other plutonium material. A previously published empirical analysis of the data available in this case yielded four distinguishable phases of wound clearance, varying in characteristic rate over 5 orders of magnitude. The 'mechanistic' analysis carried out here examines the hypothetical fractionation between material states represented in the NCRP 156 wound model that is needed to 'fit' the USTUR Case 0262 data and the goodness-of-fit so obtained.

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