

## USTUR Whole Body Case 0269: Demonstrating the Effectiveness of Delayed Ca-DTPA Therapy for Pu

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### ABSTRACT

This whole body donation case (USTUR Registrant) involved a single acute inhalation of an acidic Pu(NO<sub>3</sub>)<sub>4</sub> solution in the form of an aerosol 'mist.' Chelation treatment with i.v. Ca-EDTA was initiated on the day of the intake, and continued intermittently over 3 months. After about 3 years with no further treatment, a course of i.v. Ca-DTPA was administered. In total, 400 measurements of Pu- $\alpha$ -activity excreted in urine were recorded; starting on the day of intake (before and after the initial Ca-EDTA injection), and continuing for 37 years. This sampling included all intervals of chelation. Throughout this period, 91 measurements of Pu- $\alpha$ -activity in faeces were also recorded. The Registrant died about 38 years after the intake, at age 79 y, with extensive carcinomatosis secondary to adenocarcinoma of the prostate gland. At autopsy, all major soft tissue organs were harvested for radiochemical analyses of their <sup>238</sup>Pu, <sup>239+240</sup>Pu and <sup>241</sup>Am content. Also, as per USTUR protocol, all bones (comprising about half the skeleton) were harvested for radiochemical analyses, as well as samples of skin, subcutaneous fat and muscle. This uniquely comprehensive dataset has now been applied to derive individual-specific values of controlling transfer rate constants in the ICRP Publication 67 plutonium biokinetic model. These include 'baseline' transfer rates, representing the 'untreated' behaviour of plutonium in the various body organs of this individual; and also 'chelation-enhanced' transfer rates, representing the behaviour of blood-borne and tissue-incorporated plutonium during intervals of therapy. Best estimates of the baseline transfer rates, together with the 'enhancement factors' effective during periods of therapy were obtained by minimizing the sum of  $\chi^2$ , calculated by comparing all measured and 'modelled' values. All individual urinary and faecal excretion data points were considered, together with all organ contents at the time of death, including the subdivision of plutonium between cortical and trabecular bone. The resulting model of the separate effects of i.v. Ca-EDTA and Ca-DTPA chelation shows that the therapy administered in this case succeeded in reducing substantially the long-term burden of plutonium in all body organs, except for the lungs. The projected 'untreated' plutonium burden for the body as a whole is approximately 80% higher than the amount that was actually retained (as a result of the treatment). The calculated reductions in organ content at the time of death are approximately 40% for the liver, 60% for other soft tissues (muscle, skin, glands, etc.), 50% for the kidneys, and 50% for the skeleton. Essentially all of the achieved reduction in skeletal burden occurred in trabecular bone. Furthermore, this modelling exercise demonstrated that the major part of the inferred reductions in organ burden occurred as a result of the 3-y-delayed Ca-DTPA therapy. The predictive power of the model of i.v. Ca-EDTA and Ca-DTPA effectiveness in reducing long-term plutonium organ burdens derived from this case study will be tested against data obtained from other USTUR registrant donations. Also, the 'chelation model' developed in this study can be extended to represent the measured organ retention of 'ingrown' <sup>241</sup>Am in Case 0269. We are in process of determining the <sup>241</sup>Pu/<sup>239+240</sup>Pu ratio in the originally inhaled material; by measuring the accumulated <sup>241</sup>Am ingrowth in the original Pu-in-urine sample planchets (that were retained in this case). This presentation will outline the methods used to analyze the excretion and tissue content data, and discuss the principle conclusions from the study. The complete dataset for this case will be published on the USTUR's web site ([http://www.ustur.wsu.edu/WB\\_Studies/Case\\_0269](http://www.ustur.wsu.edu/WB_Studies/Case_0269)).

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