

Curium in the human body - USTUR case study

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Curium (Cm) is one of minor actinides presented in spent nuclear fuel. Among 19 known curium isotopes, ²⁴⁴Cm ($T_{1/2}=18.1$ y; $E_{\alpha}=5.89$ MeV) accounts for more than 90% of the total curium produced in the nuclear cycle. Compared to ²³⁸Pu, ²⁴⁴Cm has high-power output per unit mass, and is used to manufacture radioisotope thermoelectric generators. Curium can enter the human body because of occupational incidents. Due to its high specific activity, the radiotoxicity of ²⁴⁴Cm predominates over the chemical toxicity. Information on curium distribution and biokinetics in the human body is limited. The United States Transuranium and Uranium Registries' (USTUR) partial tissue donor was exposed to airborne ²⁴⁴Cm due to a glove-box failure. He died from hypertensive heart disease 52 years after the intake. A total of 35 soft tissue and 16 bone samples collected at autopsy were radiochemically analyzed for ²⁴⁴Cm. Activity concentration in systemic organs followed the pattern: skeleton>liver>kidney>muscle. The total systemic ²⁴⁴Cm activity was estimated to be 0.88 ± 0.09 Bq with 91% retained in the skeleton. A total of 0.019 ± 0.001 Bq was deposited in the respiratory tract. The activities in the respiratory tract, liver, and skeleton were used to estimate the intake and committed effective dose. The ICRP default biokinetic models, with the assumption of 83% of curium oxide, nitrate, chloride and 17% of type S material described the data well ($\chi^2= 1.54$; $p= 0.2148$). Total ²⁴⁴Cm intake was estimated as 241 Bq and the corresponding committed effective dose was 1.71 mSv.

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