

Distribution of Plutonium and Radium in the Human Heart

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Since 1968, the United States Transuranium and Uranium Registries (USTUR) has studied the biokinetics and tissue dosimetry of uranium and transuranium elements in nuclear workers. As part of the USTUR collaboration with the Million Person Study (MPS) of Low-Dose Health Effects, radiation dose to different parts of the human heart is being estimated for workers with documented intakes of ²³⁹Pu or ²²⁶Ra. The study may be expanded for workers with intakes of ²³⁸U and other radionuclides. The distribution of radionuclides, expressed in terms of concentration (Bq per kg of tissue) serves as an important parameter for estimating radiation dose. Based on available organs from workers who donated their bodies or tissues for research, nine undissected hearts were selected: seven from USTUR registrants with plutonium exposure (males) and two individuals with radium intakes (female and male). For the plutonium workers, estimated ²³⁹Pu systemic deposition ranged from <74 Bq to 1765 Bq. Estimated ²²⁶Ra 'initial systemic intakes' were 10.1 MBq and 14.8 kBq for the female patient and male worker, respectively. Organ dissection was based on a heart model published by Borrego et al (2019). This model includes nine cardiac substructures: aorta, left main coronary artery, left atrium, left anterior descending artery, left circumflex artery, left ventricle, right atrium, right coronary artery, and right ventricle. In addition, heart valves, fat attached to epicardium, fluids, and a coronary bypass graft were collected resulting in 111 samples that are currently undergoing radiochemical analyses and mass-spectrometric measurements. The ²³⁹Pu and ²²⁶Ra evaluations are not completed. The results of this study are intended to support radiation worker health studies by improving associated dosimetric and epidemiological models.

Keywords: USTUR; dosimetry; human heart; plutonium; radium workers.

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