Comparison of Organ Activity Estimates based on Bioassay Monitoring with Post-mortem Tissue Analyses

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Purpose: Monitoring data, such as urinary excretion and in-vivo body measurements are usually the primary source of information for radiation epidemiology of nuclear workers. The United States Transuranium and Uranium Registries (USTUR) complements monitoring data with postmortem tissue radiochemical analyses for modeling of actinide biokinetics and estimation of radiation doses.

Material and Methods: Uncertainties in organ activities, and radiation dose estimates from internally deposited ^{239}Pu were evaluated using a group of nine former nuclear workers. These individuals voluntarily donated their tissues to the USTUR. All nine workers were exposed to 'high-fired' PuO_2 aerosols during the same glove-box fire accident. Plutonium bioassay data for each individual included at least five positive urine measurements. For six workers, the fire was their only intake, two had an additional wound intake, and one had an additional inhalation incident.

Results: The measured plutonium activities ranged from 9.4 to 123 Bq in the liver, from 9.2 to 215 Bq in the skeleton, and from 92.9 to 7540 Bq in the lungs. Bayesian inference was used to obtain distributions of estimates of activities and doses. Latin hypercube sampling was employed to create priors of main absorption parameters (rapidly dissolved fraction, and slow dissolution rate) and selected particle transport rates. Distributions of organ activities and organ equivalent doses were generated. The distributions of plutonium activities based on bioassay measurements were compared to the measured post-mortem ^{239}Pu activities in the lungs and liver+skeleton.

Conclusion: Means of the modeled distributions differed from measured values on average by 49% for the lungs, and by 66% for the liver+skeleton.

USTUR-0647-23A