EURADOS Intercomparison on Measurements and Monte Carlo Modeling for the Assessment of Americium in a USTUR Leg Phantom

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A collaboration of the EURADOS working group on "Internal Dosimetry" and the United States Transuranium and Uranium Registries (USTUR) has taken place to carry out an intercomparison on measurements and Monte Carlo (MC) modeling for the determination of americium deposited in the bone of a USTUR leg phantom.

USTUR Case 0102 was the first whole-body donation to the U.S. Transuranium Registry (1979), of a worker affected by a substantial accidental 241Am intake. Half of this man's skeleton, encased in this tissue equivalent plastic, provides a unique human "phantom" for calibrating in vivo counting systems. In this case the 241Am skeletal activity was measured 25 years after the intake. Approximately 82% of the 241Am remaining in the body was found in the bones and teeth. It is assumed that the 241Am as fairly uniform throughout the skeleton.

A protocol has been proposed by a small group of in-vivo laboratories from Europe (CIEMAT-Spain, IRSN-France and Helmholtz Zentrum München-Germany) and Canada (HML) participating in this EURADOS/USTUR intercomparison action. The focus areas for the study included: (1) the efficiency pattern along the leg phantom using Germanium detectors (experimental and computational), (2) the comparison of MC results with experimental values of counting efficiency data and (3) the influence of Americium distribution in the bone material (volume or surface). The best counting geometry for measurement of activity has been discussed.
The 59.5 keV photons from the 241Am activity in the USTUR leg phantom were detected and evaluated with germanium detectors and gamma spectrometry methods used at the in vivo facilities participating in this EURADOS Intercomparison. An analysis of the experimental efficiency patterns found at the in-vivo facilities shows an agreement on the maximum efficiency value for the low-knee position.

A leg voxel phantom was generated by IRSN from CT scan images of the physical USTUR phantom. Homogeneous and heterogeneous distributions of the 241Am activity in the bone tissue were considered for Monte Carlo calculations. Computation at reference points were carried out for the purpose of the comparison to simulate results among participants as well for

the comparison of calculations with experimental data. Good agreement was found in the computational efficiency data when compared with the counting (experimental) calibration factors, especially for the vertical position of the germanium detector over the leg phantom.

Preliminary results this intercomparison action are presented here. It is confirmed that the application of voxel phantoms and Monte Carlo techniques to in vivo assessment of internal radionuclide body burdens is becoming an increasingly interesting alternative for calibration purposes.

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