

Estimating ²⁴¹Am Activity in the Body: Comparison of Direct Measurements and Radiochemical Analyses

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The assessment of dose and ultimately the health risk from intakes of radioactive materials begins with estimating the amount actually taken into the body. An accurate estimate provides the basis to best assess the distribution in the body, the resulting dose, and ultimately the health risk. This study continues the time-honored practice of evaluating the accuracy of results obtained using in vivo measurement methods and techniques. Results from the radiochemical analyses of the ²⁴¹Am activity content of tissues and organs from four donors to the United States Transuranium and Uranium Registries (USTUR) were compared to the results from direct measurements of radioactive material in the body performed in vivo and post mortem. Two were whole body donations and two were partial body donations. The ²⁴¹Am lung activity estimates ranged from 1 Bq to 30 Bq in the four cases. The ²⁴¹Am activity in the lungs determined from the direct measurements were within 40% of the radiochemistry results in 3 cases and within a factor of 2 for the other case. However, in one case the post mortem direct measurement estimate was a factor of 10 higher than the radiochemistry result for lung activity most probably due to underestimating the skeletal contribution to the measured count rate over the lungs. The direct measurement estimates of liver activity ranged from 2 Bq to 60 Bq and were consistently lower than the radiochemistry results. The skeleton was the organ with the highest deposition of ²⁴¹Am activity in all four cases. The skeletal activity estimates ranged from 30 Bq to 300 Bq. The skeletal activity obtained from measurements over the forehead were within 20% of the radiochemistry results in three cases and differed by 78% in the other case. The results from this study suggest that the measurement methods, data analysis methods, and calibration techniques used at the In Vivo Radiobioassay and Research Facility can be used to quantify the activity in the lungs, skeleton and liver when ²⁴¹Am activity is present in all three organs. The adjustment method used to account for the contribution from activity in other organs improved the agreement between the direct measurement results and the radiochemistry results for activity in the lung and skeleton. The method appeared to overestimate the contribution from the other organs to the liver activity measurements although the low activity levels complicated the analysis. The unadjusted liver activity estimates from the direct measurements were generally in better agreement with the radiochemistry results than the adjusted liver activity. The data from this study indicates that the results from the in vivo measurement techniques seem to provide reasonable estimates of radioactive material in the lungs and skeleton under the most challenging conditions where there is ²⁴¹Am activity in multiple organs. The data analysis from additional USTUR cases with both direct measurement results and radiochemistry results is in progress to further evaluate how best to account for the contributions from ²⁴¹Am activity in multiple organs and to better understand the uncertainty associated with the adjusted activity.