AbstractID: 6778 Title: Monte Carlo calculation of internal dose based on SPECT/CT

Purpose:
Under a radiological terrorist attack or radiation accident, victims may inhale and/or ingest radioactive materials. In this work, we investigated the possibility of using SPECT/CT to quantitatively determine spatial internal radioactivity distribution and using Monte Carlo to calculate internal organ dose due to the distribution.

Method and Materials:
A RANDO chest phantom was implanted with spatially distributed gamma-emitting radioisotopes (e.g., I-125, Ir-192, Cs-137). The SPECT and CT images of the phantom were obtained with a hybrid SPECT/CT scanner (GE Infinia). Another CT was acquired with high spatial resolution and better image quality (GE Lightspeed) and was fused with the SPECT/CT dataset using a treatment planning system (XiO, CMS). To extract spatial radioactive distribution and to prepare spatial heterogeneous anatomy for dose calculation, all imaging datasets along with the fusion matrix information from XiO were transferred into and processed with the CERR (Washington University, MO) environment and other in-house built software tools. SPECT signal was calibrated with a separate seed with known activity. With the spatial activity distribution available, The EGSnrc Monte Carlo codes were used to calculate the 3D dose rate distributions.

Results:
The relationship between the SPECT signal and the radioactivity was determined to be not simply linear for the I-125 seeds (seed activity range: 0.07 - 0.2 mCi). The software tools to use the Monte Carlo codes to calculate dose rates based on the SPECT/CT data were developed. The 3D dose distributions due to the internal irradiation and dose-volume histograms are presented.

Conclusion:
A process was developed to accurately calculate internal organ dose distribution due to internal irradiation based on SPECT/CT and using Monte Carlo methods. The data generated will be useful in developing countermeasures for radiological terrorism or radiation accidents.

Conflict of Interest:
This work is supported in part by an NIH cooperative agreement (AI067734).