Three Dimensional Dosimetry Analyses in Radionuclide Therapy using IDL and MCNP-based Software Tools

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ABSTRACT

Objectives: Patient-specific dosimetry methods using the SCMS software tool (that provides input for the MCNP radiation transport simulation code from three dimensional patient image data sets) have been extended using image-based segmentation tools. A user interface has been developed to streamline the processing of data. The objective of this study is to assess the capabilities of these tools in handling phantom and patient data sets taken from a CT-SPECT dual head gamma camera system.

Methods: The SCMS software was installed on Vanderbilt University Medical Center Unix-based machines running the MCNP code. An image-based segmentation tool was written in IDL, which uses CT or MR images to define anatomical structures and SPECT or PET data to establish activity distributions within these structures. Organ identifiers are tied to those established for the Zubal et al. voxel phantom, as is the basis for the SCMS routines. Other IDL routines provide file conversion and other utilities that provide output in the proper format for the SCMS code. Data from phantom studies and existing patient studies at Vanderbilt were processed using these tools.

Results: The SCMS code provides input to the MCNP code, so that three dimensional distributions of radiation dose can be calculated in mixed media (e.g. lung, bone and soft tissue) problems. Some limitations occur in the time needed to obtain results at the individual voxel level for some problems, thus sometimes requiring some grouping of voxel structures. The image segmentation software is flexible and adaptable to many different patient organ geometries and activity distributions, and provides input files for the SCMS code with user identification of organ regions using simultaneous paired image viewing.

Conclusions: The combination of software tools provides a powerful analytical method for three dimensional, image-based analysis of patient radiation dose in radionuclide therapy. Improvements are still needed in the user interface, the codes' ability to correct for image alignment and registration problems, and optimization of MCNP run time for individual problems.

REFERENCES

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