AbstractID: 2552 Title: Monte Carlo Calculation of Absorbed Dose to Structures in Central Nervous System from Intrathecally Administered Yttrium-90

Intrathecal administration of I-131 labeled monoclonal antibody to CSF has been reported for the therapeutic treatment of CSF malignancies. Geometrical phantoms and MIRD formalism was used in the calculation of absorbed doses to neighboring structures. The purpose of this work is to calculate of the average absorbed dose to structures of the Central Nervous System from intrathecally administered Y-90 using digital phantom and Monte Carlo analysis.

Method and Materials: Monte Carlo simulation of the energy deposition of Y-90 in anatomic model of ventricular spaces and spinal structures of the CNS tissue are used to calculate the dose to the Cerebral Spinal Fluid (CSF), meningeal structures of the spinal column and ventricular regions of the brain. Two three-dimensional phantoms, one for brain's ventricles and the other for 1.5 cm section of the spinal column were developed from MRI and visual woman images respectively. Voxel dimensions were in the order of (0.33 mm^3) for the study. A Monte Carlo energy deposition model for Y90 was used as point kernel and convolved with the model images to obtain final dose distribution. Calculation method was verified with I-131.

Results: The average doses to the ventricular meninges, CSF and optic chiasm were calculated to be 2.4, 4.4 and 0.33 cGy/MBq of injected Y-90 respectively. For intrathecally administered I-131, the average dose for subarachnoid CSF and Pia mater were 1.31 and 0.34 cGy/MBq in this work while published results using the MIRD formalism reported values of 1.96 and 0.36 cGy/MBq respectively. Average doses to six spinal structures using administered Y-90 will also be presented.

Conclusion: This work describes a useful technique for calculating absorbed dose and dose distribution to CSF and surrounding structures for the treatment of CSF malignancies by intrathecal injection. This approach can be used in similar therapeutic applications involving Y-90.