

AbstractID: 11226 Title: Methods of Assessing the Dose to the Red Bone Marrow for Diagnostic and Therapeutic Procedures

Purpose: To demonstrate a more accurate method of assessing whole body red bone marrow dose in clinical applications.

Method and Materials: Assessment of methods of red bone marrow (RBM) dose calculations is performed using a model constructed from the CT data of the Visible Human Project (VHP) and the EGS4 Monte Carlo code. Calculation of local marrow dose is achieved using the CT Number Method, which describes the fraction of marrow in a given CT voxel. Calculation of whole-body average RBM dose is performed using two methods: one that assumes an homogeneous mixture of red and yellow bone marrow (HM Method), and one that uses a cellularity-factor weighted marrow mixture in each bone (CW Method). Distribution of RBM mass in the skeleton calculated using both methods are compared to the color photograph data of the VHP used to construct the VIP-Man anatomical model. Red bone marrow doses are calculated for broad beam exposures over a large energy range, and for several clinical applications including various CT scan protocols and electron whole-body irradiation treatments.

Results: The average difference in red bone marrow mass in each bone segment compared to the quantity present in VIP-Man is 45% smaller when calculated with the CW method than the HM method. For clinical CT protocols, the RBM dose shows significant differences, up to 33% for head scans and 25% for abdominal scans. For the electron whole-body irradiation (WBI) treatments, the RBM dose differs by 39%.

Conclusion: Two common methods for calculating whole body average red bone marrow dose have been compared to the observed distribution standard available in the Visible Human Project data. Significant differences in dose are observed between the two methods, suggesting the importance of using appropriate cellularity factors in calculating red bone marrow dose.