

Purpose: To develop computational lymph node models implemented within a series of pediatric hybrid phantoms which can be utilized for nuclear medicine dosimetry

Methods: The algorithm for generating lymphatic nodes within adult hybrid phantom which we previously reported was improved to use for International Commission on Radiological Protection (ICRP)-compliant pediatric hybrid phantoms which include newborn, 1-year, 5-year, 10-year, and 15-year male and female phantoms. First, a total of 16 lymphatic node anatomical sites were defined within the pediatric hybrid phantoms: extrathoracic, cervical, thoracic (upper and lower), breast (left and right), mesentery (left and right), axillary (left and right), cubital (left and right), inguinal (left and right), and popliteal (left and right) nodal regions. Second, individual lymphatic node positions are randomly sampled in spherical tissue volume centered at each of the previously selected lymphatic node regions. Third, tissue spheres representing individual lymphatic nodes are then created to populate each nodal region of the phantom, with the normal standard nodal diameter until a total lymphatic node mass is achieved to match age-dependent total reference masses derived from ICRP Publication 66 and 89 reference data. The lymphatic nodes were generated within a total of 10 pediatric hybrid phantoms and coupled with a Monte Carlo code, MCNPX2.6 to estimate radionuclide S values for I-131 distributed within different lymphatic node sites.

Results: Lymphatic node models of which masses were matched to ICRP reference values were implemented into the pediatric hybrid phantom series. An illustrative set of radionuclide S values for I-131 were calculated where regional lymphatic nodes are considered to be independent source and target regions of patient.

Conclusion: The new lymphatic node model suggested in this study can be utilized to obtain anatomically realistic dosimetry in lymphoma patients treated by radionuclide therapy.