AbstractID: 11320 Title: Second cancer risk from secondary neutrons for a boy who received proton craniospinal irradiation

Purpose: Proton fields used in radiotherapy expose healthy tissue to secondary neutrons emanating from the treatment unit (or "external neutrons") and produced within the patient (or "internal neutrons"), which provide no known benefit to the patient and may increase a patient's risk of developing a second cancer. The objectives of this study were to calculate equivalent doses to organs and tissues and to estimate second cancer risk from secondary neutrons for a boy who received craniospinal irradiation (CSI) with proton beams. **Method and Materials:** Using Monte Carlo simulations, equivalent dose from secondary neutrons was calculated in organs and tissues for the 10-year-old boy. In order to maximize the accuracy and realism of the simulations, the geometric model comprised a detailed passive-scattering proton treatment unit and a voxelized phantom that was created from the actual CT images of the patient. All treatment fields were included. The proton treatment included CSI at 30.6 Gy plus a boost of 23.4 Gy to the clinical target volume in the brain. Based on the equivalent dose values, effective dose and second cancer risk from secondary neutrons were predicted. **Results:** The effective dose from secondary neutrons was 418 mSv, of which 344 mSv was from external neutrons and 74 mSv was from internal neutrons. The lifetime attributable risks of second cancer incidence and mortality were 6.2% and 3.4%, respectively. The cancer sites that carried the highest risks were the lungs, colon, and thyroid. The risks were predominated by the two spinal fields; very little risk was associated with the boost fields. **Conclusion:** The results of this study provide an estimate of the secondary neutron dose and corresponding risk for a pediatric patient undergoing proton CSI and support the suitability of passively-scattered proton beams for the treatment of tumors of the central nervous system in children.