Projected Second Tumor Risk and Dose to Neurocognitive Structures After Proton Versus Photon Radiotherapy for Benign Meningioma.

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Abstract

PURPOSE: To calculated projected second tumor rates and dose to organs at risk (OAR) in patients with benign intracranial meningioma (BM), according to dosimetric comparisons between proton radiotherapy (PRT) and photon radiotherapy (XRT) treatment plans.

METHODS AND MATERIALS: Ten patients with BM treated at Massachusetts General Hospital during 2006-2010 with PRT were replanned with XRT (intensity-modulated or three-dimensional conformal radiotherapy), optimizing dose to the tumor while sparing OAR. Total dose was 54 Gy in 1.8 Gy per fraction for all plans. We calculated equivalent uniform doses, normal tissue complication probabilities, and whole brain-based estimates of excess risk of radiation-associated intracranial second tumors.

RESULTS: Excess risk of second tumors was significantly lower among PRT compared with XRT plans (1.3 vs. 2.8 per 10,000 patients per year, p < 0.002). Mean equivalent uniform doses were lower among PRT plans for the whole brain (19.0 vs. 22.8 Gy, p < 0.0001), brainstem (23.8 vs. 35.2 Gy, p = 0.004), hippocampi (left, 13.5 vs. 25.6 Gy, p < 0.0001; right, 7.6 vs. 21.8 Gy, p = 0.001), temporal lobes (left, 25.8 vs. 34.6 Gy, p = 0.007; right, 25.8 vs. 32.9 Gy, p = 0.008), pituitary gland (29.2 vs. 37.0 Gy, p = 0.047), optic nerves (left, 28.5 vs. 33.8 Gy, p = 0.04; right, 25.1 vs. 31.1 Gy, p = 0.07), and cochleas (left, 12.2 vs. 15.8 Gy, p = 0.39; right, 15.5 vs. 8.8 Gy, p = 0.01). Mean normal tissue complication probability was <1% for all structures and not significantly different between PRT and XRT plans.

CONCLUSIONS: Compared with XRT, PRT for BM decreases the risk of RT-associated second tumors by half and delivers significantly lower doses to neurocognitive and critical structures of vision and hearing.

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