Whole Brain Irradiation With Hippocampal Sparing and Dose Escalation on Multiple Brain Metastases: A Planning Study on Treatment Concepts.

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Abstract

PURPOSE: To develop a new treatment planning strategy in patients with multiple brain metastases. The goal was to perform whole brain irradiation (WBI) with hippocampal sparing and dose escalation on multiple brain metastases. Two treatment concepts were investigated: simultaneously integrated boost (SIB) and WBI followed by stereotactic fractionated radiation therapy sequential concept (SC).

METHODS AND MATERIALS: Treatment plans for both concepts were calculated for 10 patients with 2-8 brain metastases using volumetric modulated arc therapy. In the SIB concept, the prescribed dose was 30 Gy in 12 fractions to the whole brain and 51 Gy in 12 fractions to individual brain metastases. In the SC concept, the prescription was 30 Gy in 12 fractions to the whole brain followed by 18 Gy in 2 fractions to brain metastases. All plans were optimized for dose coverage of whole brain and lesions, simultaneously minimizing dose to the hippocampus. The treatment plans were evaluated on target coverage, homogeneity, and minimal dose to the hippocampus and organs at risk.

RESULTS: The SIB concept enabled more successful sparing of the hippocampus; the mean dose to the hippocampus was 7.55 ± 0.62 Gy and 6.29 ± 0.62 Gy, respectively, when 5-mm and 10-mm avoidance regions around the hippocampus were used, normalized to 2-Gy fractions. In the SC concept, the mean dose to hippocampus was 9.8 ± 1.75 Gy. The mean dose to the whole brain (excluding metastases) was 33.2 ± 0.7 Gy and 32.7 ± 0.96 Gy, respectively, in the SIB concept, for 5-mm and 10-mm hippocampus avoidance regions, and 37.23 ± 1.42 Gy in SC.

CONCLUSIONS: Both concepts, SIB and SC, were able to achieve adequate whole brain coverage and radiosurgery-equivalent dose distributions to individual brain metastases. The SIB technique achieved better sparing of the hippocampus, especially when a10-mm hippocampal avoidance region was used.