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Abstract

Proton Stereotactic Radiosurgery for Brain Metastases: A Single Institution Analysis of 370 Patients

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Objectives: Proton stereotactic radiosurgery (PSRS) produces characteristic dose distributions distinct from photon linear accelerator or Cobalt-60 SRS systems. While outcomes of PSRS treatment of benign intra-cranial lesions have been well-described, there is a paucity of data on the use of PSRS for brain metastases. This single institution study is the first to report survival outcomes and failure patterns for patients with single or multiple brain metastases treated with PSRS.

Methods: Retrospective study of 813 metastases from 370 patients treated with PSRS between April 1991 and November 2016. Local control and distant brain failure was determined by radiographic surveillance (contrast-enhanced MRI or CT if MRI unavailable or contraindicated). Kaplan-Meier analysis was used to evaluate overall survival and the cumulative incidence of local control and distant brain failure from the date of first PSRS.

Results: The median follow-up from the time of first PSRS was 9 months. Primary disease sites included lung (39%), skin (melanoma, 26%), breast (17%), renal (5%), head and neck (4%), and other (9%). The median age at time of PSRS was 61 years (range, 20-93). The number of metastases treated with PSRS per patient was 1 (47%), 2-4 (43%), >4 (10%), with a median of 2 (range, 1-16). The median treated lesion size was 0.6 cc (range, 0.02 - 23.2 cc), with a median delivered PSRS dose of 18 Gy (relative biological effectiveness, RBE; range, 8-28 GyRBE). The 6-month and 1-year rates of local control were 93.8% (95% CI, 91.7 – 95.4%) and 84.0% (95% CI, 80.4 – 87.0%), respectively. The 6-month and 1-year distant brain failure rates were 42.9% (95% CI, 37.8 – 48.5%) and 57.5% (95% CI, 51.8 – 63.3%), respectively. Overall survival at 6 months was 76.0% (95% CI, 71.3 – 80.0%) and 51.5% at 1-year (95% CI, 46.3 – 56.5%). The median survival was 12.4 months (95% CI, 10.8 – 14.0) following PSRS and 18.1 months (95% CI, 16.1 – 20.1) following diagnosis of brain metastases.

Conclusions: This is the first reported series of PSRS for the management of brain metastases. These results suggest that moderate dose PSRS can achieve good local control outcomes comparable to those achieved with conventional SRS strategies. While widespread use of PSRS for brain metastases remains resource intensive, future strategies evaluating the selective utility of PSRS in patients with brain metastases, particularly in the era of molecularly targeted

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systemic therapy, should be explored.