Evaluation of Brainstem Lesions Treated with Linac-Based Hypofractionated Stereotactic Radiosurgery

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Objectives: Summarize the doses received on patients with brainstem metastases treated with hypofractionated stereotactic radiosurgery.

Methods: Retrospective review of patients treated with stereotactic radiosurgery in 5 fractions from 2014-2019 for intracranial brainstem lesion or lesions in close proximity to the brainstem. Varian Eclipse v13.7 TPS was used to contour structures including GTV plus 2mm margin for PTV prescription target. Dose to normal brainstem was examined as brainstem minus GTV (Brainstem-GTV). MR imaging was performed at usual follow up intervals, which was typically every 3 months for metastases, and every 6-12 months for benign lesions. Tumor control and concern for necrosis was assessed on these follow up MRIs. Any increase in size of enhancement was deemed possible recurrence or necrosis. MRI spectroscopy was done to further evaluate when there was clinical concern.

Results: Total patients evaluated was 43. 5 fraction treatment doses schema from 20Gy - 31.25Gy. 4/43 patients were treated with static 3D fields; 39/43 patents were treated VMAT. GTV volumes ranged from 0.1cc - 47.2cc with GTV mean volume 8.4cc +/- 9.0cc. Brainstem-GTV max dose range was 642.1cGy - 3208.1cGy with mean dose 2356.2cGy +/- 733.7cGy. Brainstem-GTV D0.5cc range was from 450.7cGy - 2780.1cGy. Data from hypofractionated patients was compared data in literature1, 2 regarding SRS single fraction treatment where Brainstem-GTV D0.5cc is 1000cGy and Brainstem-GTV max is 1500cGy. Of the 43 patient plans evaluated for brainstem dose, 26 received follow up MR. MR spectroscopy was used to evaluate two cases of concern for recurrent disease in the region adjacent to the brainstem. Both of these lesions were within the prior treatment field. An additional patient had radionecrosis in a region of brain that was away from the brainstem and had a course of SRS previously, in addition to having received whole brain radiation therapy 40 years prior.

Conclusions: Patient data included in study were hypofractionated stereotactic radiosurgery delivered with 3D and VMAT techniques. Diagnosis varied with primary as meningioma, chordoma, schwannoma, melanoma, esophageal, lung, breast, pituitary and endometrial cancers. When multiple GTVs being treated with one isocenter, GTV volume considered as part of study were within 2cm of brainstem. Post-RT necrosis was evaluated by diagnostic radiologist while the original GTV contouring performed by neurosurgery. However, the study demonstrated that hypofractionated stereotactic radiosurgery can result in less radiation necrosis and similar local control when compared with single fraction radiosurgery. Dose escalation of lesions adjacent to the brainstem can be considered, and may be more feasible with a hypofractionated regimen of 5 fractions. We will use the current mean and maximal doses provided here to begin dose escalation.