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Dosimetric evaluation and treatment planning considerations for GammaTile permanent brain implants – a pilot, institutional experience

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Abstract

Purpose: GammaTile® (GT) is a brachytherapy platform that received Federal Drug Administration (FDA) approval as brain tumor therapy in late 2018. Here, we reviewed our institutional experience with GT as treatment for recurrent glioblastomas and characterized dosimetric parameter and associated clinical outcome.

Methods and materials: A total of 20 consecutive patients with 21 (n = 21) diagnosis of recurrent glioblastoma underwent resection followed by intraoperative GT implant between 01/2019 and 12/2020. Data on gross tumor volume (GTV), number of GT units implanted, dose coverage for the high-risk clinical target volume (HR-CTV), measured by D₉₀ or dose received by 90% of the HR-CTV, dose to organs at risk, and six months local control were collected.

Results: The median D₉₀ to HR-CTV was 56.0 Gy (31.7-98.7 Gy). The brainstem, optic chiasm, ipsilateral optic nerve, and ipsilateral hippocampus median D_{max} were 11.2, 5.4, 6.4, and 10.0 Gy, respectively. None of the patients in this study cohort suffered from radiation necrosis or adverse events attributable to the GT. Correlation was found between pre-op GTV, the volume of the resection cavity, and the number of GT units implanted. Of the resection cavities, 7/21 (33%) of the cavity experienced shrinkage, 3/21 (14%) remained stable, and 11/21 (52%) of the cavities expanded on the 3-months post-resection/GT implant MRIs. D₉₀ to HR-CTV was found to be associated with local recurrence at 6-month post GT implant, suggesting a dose response relationship (p = 0.026). The median local recurrence-free survival was 366.5 days (64-1,098 days), and a trend towards improved local recurrence-free survival was seen in patients with D₉₀ to HR-CTV ≥ 56 Gy (p = 0.048).

Conclusions: Our pilot, institutional experience provides clinical outcome, dosimetric considerations, and offer technical guidance in the clinical implementation of GT brachytherapy.

Keywords: Brachytherapy; Dosimetry; GammaTile; Glioblastoma; Radiotherapy; Treatment planning.

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