Repeat stereotactic radiosurgery as salvage therapy for locally recurrent brain metastases previously treated with radiosurgery.

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Abstract

OBJECTIVE There are a variety of salvage options available for patients with brain metastases who experience local failure after stereotactic radiosurgery (SRS). These options include resection, whole-brain radiation therapy, laser thermoablation, and repeat SRS. There is little data on the safety and efficacy of repeat SRS following local failure of a prior radiosurgical procedure. This study evaluates the clinical outcomes and dosimetric characteristics of patients who experienced tumor recurrence and were subsequently treated with repeat SRS. METHODS Between 2002 and 2015, 32 patients were treated with repeat SRS for local recurrence of ≥ 1 brain metastasis following initial SRS treatment. The Kaplan-Meier method was used to estimate time-to-event outcomes including overall survival (OS), local failure, and radiation necrosis. Cox proportional hazards analysis was performed for predictor variables of interest for each outcome. Composite dose-volume histograms were constructed for each reirradiated lesion, and these were then used to develop a predictive dosimetric model for radiation necrosis. RESULTS Forty-six lesions in 32 patients were re-treated with a second course of SRS after local failure. A median dose of 20 Gy (range 14-22 Gy) was delivered to the tumor margin at the time of repeat SRS. Local control at 1 year was 79% (95% CI 67%-94%). Estimated 1-year OS was 70% (95% CI 55%-88%). Twelve patients had died at the most recent follow-up, with 8/12 patients experiencing neurological death (as described in Patchell et al.). Eleven of 46 (24%) lesions in 11 separate patients treated with repeat SRS were associated with symptomatic radiation necrosis. Freedom from radiation necrosis at 1 year was 71% (95% CI 57%-88%). Analysis of dosimetric data revealed that the volume of a lesion receiving 40 Gy (V40Gy) was the most predictive factor for the development of radiation necrosis (p = 0.003). The following V40Gy thresholds were associated with 10%, 20%, and 50% probabilities of radiation necrosis, respectively: 0.28 cm³ (95% CI 3%-28%), 0.76 cm³ (95% CI 9%-39%), 1.60 cm³ (95% CI 26%-74%). CONCLUSIONS Repeat SRS appears to be an effective salvage option for patients with brain metastases experiencing local failure following initial SRS treatment. This series demonstrates durable local control and, although rates of radiation necrosis are significant, repeat SRS may be indicated for select cases of local disease recurrence. Because the V40Gy is predictive of radiation necrosis, limiting this value during treatment planning may allow for a reduction in radiation necrosis rates.

KEYWORDS: CTCAE = Common Terminology Criteria for Adverse Events; DVH = dose-volume histogram;
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