Cureus

The Triple Threat-Adaptive Radiosurgery for Brain Metastases via Gamma Knife Icon

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Abstract
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Abstract

Objectives:

We highlight tumor volume changes and locoregional control rates from our single-institution retrospective cohort of patients with large brain metastases treated with adaptive gamma-knife stereotactic radiosurgery (GKSRS).

Methods:

Our retrospective cohort analysis included patients who completed adaptive radiosurgery, labeled the triple treat, from September 2021 to September 2022 in our department. Patients underwent three treatments followed by a three-week break. This was followed by a repeat MRI. A triplet of options was available at this time with respect to volume: the target volume could remain the same, increase, or decrease.

Patients were excluded if they died, failed to tolerate, or lost follow-up during treatment. We utilized radiation oncology, medical oncology, and neurosurgery follow-up visits to assess for treatment-related toxicities, which were graded with the Criteria Terminology Criteria for Adverse Events. Follow-up, overall survival (OS), and time to local progression were calculated from date of first treatment to the event of interest. We utilized Kaplan-Meier and Fine-Gray analysis to calculate OS and cumulative incidence of local progression with death as a competing risk.

Results:

A total of 25 patients with 39 lesions underwent adaptive GKSRS for large, ⩾ 2 cm metastases or metastases in eloquent locations and/or with significant edema. The median age of patients at first treatment was 56 years (interquartile range 46-63). The most common primary sites were breast (40%), lung (23%), and renal (15%). The median Karnofsky Performance Scale was 90 (interquartile range 80-100).

Patients were treated to a median total dose of 30 Gy (range 18-34) prescribed to a median isodose line 53% (range 38-88) in 5 fractions. As a part of the triple threat regimen, patients received three fractions (range 1-4) followed by a 3-week break (range 1-4) before delivering the remaining treatments. Thirty-four lesions received a cumulative dose of 30 Gy (6 Gy x 5), two lesions received a cumulative dose of 25 Gy (5 Gy x 5), one lesion received a cumulative dose of 34 Gy (6 Gy x 3 followed by 8 Gy x 2), and one lesion received 28 Gy (6 Gy x 3 followed by 5 Gy x 2). One lesion demonstrated progression during treatment and received 18 Gy (6 Gy x 3) prior to undergoing salvage surgical resection.

Of the 39 lesions, the average lesion initial tumor volume prior to radiotherapy was 8.4 cm3 (range 0.2-37.5). Of the 38 lesions that completed the full radiotherapy course, the average volume obtained from the intra-treatment MRI was 5.2 cm3 (range 0.1-35.2) reflecting an average lesion volume decrease of 38.1% from the initial to the re-planning treatment volume.

The median follow-up time from the first treatment was 6 (interquartile range 3-8) months. Four of 39 (10.5%) lesions demonstrated local progression. The estimated cumulative incidence of local progression at 6-months was 9.4%, corresponding to a 6-month local control rate of 91.6%. The six-month OS was 80%. No patients experienced a CTCAE grade ⩾ 3 toxicity related to GKSRS. Only one lesion (3%) demonstrated

imaging evidence of radiation necrosis, and this lesion was clinically asymptomatic CTCAE grade I for CNS necrosis.

Conclusion(s):

Patients who received adaptive radiosurgery for brain metastases experience a profound decrease in tumor volume. Our results show control is similar to alternative staged and fractionated radiosurgery approaches. Our regimen may further reduce the risk of necrosis compared these other fractionated/staged regimens and offer an option for the high-risk metastases.