Cureus

Radiographic Outcomes of Small Brain Metastases (<2 cm) Treated with Multi-Fraction vs. Single-Fraction Stereotactic Radiosurgery

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Abstract
Published 02/02/2024

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Categories: Neurosurgery, Radiation Oncology, Oncology
Keywords: radiation-induced brain necrosis, external beam radiation, dose-fractionation, brain srs, brain met

How to cite this abstract
Del Balzo L, Khaleel S, Gaeta B, et al. (February 02, 2024) Radiographic Outcomes of Small Brain Metastases (<2 cm) Treated with Multi-Fraction vs. Single-Fraction Stereotactic Radiosurgery . Cureus 16(2): a1196

Abstract

Purpose

Brain metastases (BM) are becoming increasingly common across histologies due to robust overall survival (OS) and primary tumor control with chemotherapeutics and immunotherapies. As such, the management of intracranial metastases is posed to increase in frequency and necessity. Current protocols indicate treating patients with large lesions (>2 cm) with multi-fraction (MF) and treating those with smaller lesions (<2 cm) with single-fraction (SF); however, it is unclear if SF treatment is superior in lesion-control to MF in BMs <2 cm.

Methodology

Patients across histologies with radiographically confirmed BM that were treated with SRS between 2010-2020 at MSKCC were included. Patients who received whole-brain radiotherapy (WBRT) as part of their initial treatment were excluded, as were those who lacked baseline imaging.

Patient and lesion-level data were extracted from clinical notes and contrast-enhanced brain MRIs. Lesions were measured by their largest diameter in axial post-contrast T1-weighted brain MRIs. Median times to outcomes were assessed with Kaplan-Meier analysis. Correlations between outcomes and baseline characteristics were evaluated with chi-square and Cox regressions. Local failure (LF) was defined as enlargement of a lesion post-treatment in the largest axial diameter by at least 25%. A composite primary endpoint of lesion-level changes concerning for either LF or radionecrosis (RN) was used. RN is a potential toxicity of radiotherapy, in which irreversible radiation damage to small vessels in the surrounding parenchyma causes decreased perfusion and necrosis. Clinically, this can manifest similarly to LF, as RN can form expansile lesions.

Results

206 patients with a total of 806 lesions were reviewed (41.5% NSCLC, 11.2% melanoma, 10.7% breast, 36.6% other), with 123 female patients (59.7%). Median time to BM presentation after primary diagnosis was 14.8 months. Median KPS at BM presentation was 80 (range 40-100), and 52% of patients were symptomatic at BM presentation. Median OS from BM diagnosis was 11.9 months.

Of 723 lesions 2 cm or smaller, 563 had follow-up imaging. The median diameter of the lesions was 8.0 mm (7.3 mm SF, 10.4 mm MF, $p<0.05$) with a median planned treatment volume (PTV) of 1.27 cm3 (1.05 cm3 SF, 2.11 cm3 MF, $p<0.05$). Of these 563 lesions, 339 were treated with SF (median 21Gy, range 18 Gy-21 Gy) and 224 lesions were treated with MF (median 27 Gy, range 23 Gy-30 Gy in 3-5 fractions) due to concurrent treatment of other larger lesions.

The composite endpoint of LF or RN for the full cohort was 24% (28% SF, 20% MF, $p<0.05$) with a median time to this endpoint of 5.4 months (5.0 months SF, 6.1 months MF).

Conclusion

We present a large cohort of patients with BMs <2 cm treated with SF and MF SRS. On a lesion-level basis, MF SRS was associated with a lower overall rate of LF or RN, despite the lesions having a larger diameter and

PTV. Ongoing analyses explore rates of RN and genomic features that may further explain differences in oncologic outcomes.