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Abstract

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The Utility of "Pre-Planning" MRI in the Prevention of Inadvertent Frame Placement for the Treatment of Brain Metastasis during Gamma Knife Radiosurgery

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Abstract

Objective: Stereotactic radiosurgery (SRS) is an effective treatment for patients with brain metastasis. The acquisition of a high-resolution planning MRI is critical to decision making for such patients. With the introduction of the Gamma Knife Icon, the stereotactic reference can now be defined via cone-beam CT instead of classic fiducial-based registration. Therefore, patients who receive Gamma Knife SRS are able to undergo a "pre-planning" MRI and have their radiation plan generated prior to their treatment day or frame placement. Since extent of disease may be different in a pre-planning MRI compared to routine surveillance MRI, our purpose was to review our experience using pre-planning MRI to assess changes in ultimate treatment recommendation and prevention of unnecessary frame placement.

Methods: We performed a retrospective review of all patients treated at our institution who underwent SRS for brain metastases since the introduction of the Gamma Knife Icon at our center, from January 2017 to January 2020. Details about the pre-planning MRI date, treatment delivery date and salient treatment details were obtained. Patients were categorized based on the following eight groups: conversion to whole brain radiation (WBRT), conversion to surgery, conversion to linac-based SRS, disease resolution due to systemic therapy, hospice, death, refusal of treatment or transfer of care. Chi-square test was performed on patient demographics to assess relationship between initial and ultimate plan.

Results: We identified 360 patients eligible for the study criteria. Of these, pre-planning MRI was performed in 257 patients (71.4%). Among patients with pre-planning MRI, 213 patients (82.9%) received SRS as originally intended, while 44 patients (17.1%) had a change from their initial recommendation. Among these patients, 22 patients (8.6%) were converted to WBRT, 2 patients (0.8%) were converted to surgery, 2 patients (0.8%) were converted to Linac-based SRS, 9 patients (3.5%) underwent observation due to resolution/stable disease from systemic therapy, 4 patients (1.6%) opted for hospice, 3 patients (1.2%) died prior to treatment, 1 patient (0.4%) refused treatment and 1 patient (0.4%) transferred care to another center. Therefore, 35 patients (13.6% of all pre-planned cases) were converted to a different treatment (WBRT, surgery, linac, or observation) and thus avoided inadvertent frame placement. Of all demographics, only renal cell histology was of borderline significance ($p=0.07$) favoring change from initial treatment recommendation.

Conclusion: In our institution, pre-planning MRI is used in the majority of Gamma Knife SRS cases involving brain metastases. A total of 13.6% of these cases were cancelled after pre-planning MRI for various reasons, effectively sparing unnecessary frame placement in these patients. Conversion to WBRT and resolution of disease due to systemic therapy are the most common reasons for treatment cancellations.