Patterns of failure after proton therapy in medulloblastoma; linear energy transfer distributions and relative biological effectiveness associations for relapses.


Abstract

PURPOSE: The pattern of failure in medulloblastoma patients treated with proton radiation therapy is unknown. For this increasingly used modality, it is important to ensure that outcomes are comparable to those in modern photon series. It has been suggested this pattern may differ from photons because of variations in linear energy transfer (LET) and relative biological effectiveness (RBE). In addition, the use of matching fields for delivery of craniospinal irradiation (CSI) may influence patterns of relapse. Here we report the patterns of failure after the use of protons, compare it to that in the available photon literature, and determine the LET and RBE values in areas of recurrence.

METHODS AND MATERIALS: Retrospective review of patients with medulloblastoma treated with proton radiation therapy at Massachusetts General Hospital (MGH) between 2002 and 2011. We documented the locations of first relapse. Discrete failures were contoured on the original planning computed tomography scan. Monte Carlo calculation methods were used to estimate the proton LET distribution. Models were used to estimate RBE values based on the LET distributions.

RESULTS: A total of 109 patients were followed for a median of 38.8 months (range, 1.4-119.2 months). Of the patients, 16 experienced relapse. Relapse involved the supratentorial compartment (n=8), spinal compartment (n=11), and posterior fossa (n=5). Eleven failures were isolated to a single compartment; 6 failures in the spine, 4 failures in the supratentorium, and 1 failure in the posterior fossa. The remaining patients had multiple sites of disease. One isolated spinal failure occurred at the spinal junction of 2 fields. None of the 70 patients treated with an involved-field-only boost failed in the posterior fossa outside of the tumor bed. We found no correlation between Monte Carlo-calculated LET distribution and regions of recurrence.

CONCLUSIONS: The most common site of failure in patients treated with protons for medulloblastoma was outside of the posterior fossa. The most common site for isolated local failure was the spine. We recommend consideration of spinal imaging in follow-up and careful attention to dose distribution in the spinal junction regions. Development of techniques that do not require field matching may be of benefit. We did not identify a direct correlation between lower LET values and recurrence in medulloblastoma patients treated with proton therapy. Patterns of failure do not appear to differ from those in patients...
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