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CLINICAL STUDY - PATIENT STUDY

Survival benefit of Boron neutron capture therapy for recurrent malignant gliomas

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Abstract We have applied boron neutron capture therapy (BNCT) to malignant brain tumors. Here we evaluated the survival benefit of BNCT for recurrent malignant glioma (MG). Since 2002, we have treated 22 cases of recurrent MG with BNCT. Survival time was analyzed with special reference to recursive partitioning analysis (RPA) classification, by Carson et al. (J Clin Oncol 25:2601–2606, 2007). Median survival times (MSTs) after BNCT for all patients and for glioblastoma as on-study histology at recurrence was 10.8 months ($n = 22$; 95% CI, 7.3–12.8 months) and 9.6 months ($n = 19$; 95% CI, 6.9–11.4 months), respectively. In our study, MST for the high-risk RPA classes was 9.1 months ($n = 11$; 95% CI, 4.4–11.0 months). By contrast, the original journal data showed that the MST of the same RPA classes was 4.4 months ($n = 129$; 95% CI, 3.6–5.4 months). BNCT showed a survival benefit for recurrent MG, especially in the high-risk group.

Keywords BNCT · BPA–PET · GBM · MG · RPA

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Introduction

We have applied a form of tumor-selective particle radiation, boron neutron capture therapy (BNCT), for malignant gliomas (MGs) [1, 2] and malignant meningiomas [3, 4]. BNCT comprises a binary approach [5]: a boron-10 (^{10}B)-labeled compound is administered that delivers high concentrations of ^{10}B to the target tumor relative to the surrounding normal tissues. This is followed by irradiation with thermal neutrons. When neutrons collide into ^{10}B atoms, high linear-energy-transfer (LET) alpha and ^{7}Li particles are released from the ^{10}B (n, alpha) ^{7}Li neutron capture reaction. The short range (5–9 micrometers) of these particles allows for relatively selective tumor killing without significant damage to the adjacent normal brain tissue.

The prognosis of recurrent MGs, especially glioblastoma multiforme (GBM) is poor [6]. We reported the effectiveness of BNCT on neuroimages for MGs [1, 2], and recently reported the survival benefit of BNCT for newly diagnosed MGs [7]. Unfortunately, the standard treatment for recurrent MG has not yet been established. Therefore, evaluation of the survival benefit of BNCT for recurrent MGs is difficult. Also with limited case numbers like this study, it is difficult to elucidate some objective assessments