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Boron neutron capture therapy for glioblastoma

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Abstract

Boron neutron capture therapy (BNCT) theoretically allows the preferential destruction of tumor cells while sparing the normal tissue, even if the cells have microscopically spread to the surrounding normal brain. The tumor cell-selective irradiation used in this method is dependent on the nuclear reaction between the stable isotope of boron (^{10}B) and thermal neutrons, which release α and ^{7}Li particles within a limited path length (−9μm) through the boron neutron capture reaction, $^{10}B(n,\alpha)\,^{7}Li$. Recent clinical studies of BNCT have focused on high-grade glioma and cutaneous melanoma; however, cerebral metastasis of melanoma, anaplastic meningioma, head and neck tumor, and lung and liver metastasis have been investigated as potential candidates for BNCT. To date, more than 350 high-grade gliomas have been treated in BNCT facilities worldwide. Current clinical BNCT trials for glioblastoma (GBM) have used the epithermal beam at a medically optimized research reactor, and *p*-dihydroxyboryl-phenylalanine (BPA) and/or sulfhydryl borane $Na_2B_{12}H_{11}SH$ (BSH) as the boron delivery agent(s). The results from these rather small phase I/II trials for GBM appear to be encouraging, but prospective randomized clinical trials will be needed to confirm the efficacy of this theoretically promising modality. Improved tumor-targeting boron compounds and optimized administration methods, improved boron drug delivery systems, development of a hospital-based neutron source, and/or other combination modalities will enhance the therapeutic effectiveness of BNCT in the future.

Keywords: Glioma, BNCT, Radiation, Cancer

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