

Boron neutron capture therapy

Boron neutron capture therapy is based on a **nuclear reaction** between the nonradioactive isotope boron-10 and either low-energy thermal neutrons or high-energy epithermal neutrons, which generate high linear energy transfer α particles and a recoiled lithium nucleus (${}^7\text{Li}$) that selectively destroys the DNA helix in tumor cells. Boron neutron capture therapy is an emerging procedure aimed at improving the therapeutic ratio for the traditional treatment of various malignancies, which has been studied clinically in a variety of diseases, including glioblastoma, head and neck cancer, cutaneous melanoma, hepatocellular carcinoma, lung cancer, and extramammary Paget's disease. However, boron neutron capture therapy has not been clinically performed for urological cancers, excluding genital extramammary Paget's disease that appeared at the scrotum to penis area. In this review, we aimed to provide an updated summary of the current clinical literature of patients treated with boron neutron capture therapy and to focus on the future prospects of boron neutron capture therapy for urological cancers ¹⁾.

Boron Neutron capture therapy (NCT) is a noninvasive therapeutic modality for treating locally invasive malignant tumors such as primary brain tumors and recurrent head and neck cancer.

It is a two step procedure: first, the patient is injected with a tumor localizing drug containing a non-radioactive isotope that has a high propensity or cross section (σ) to capture slow neutrons. The cross section of the capture agent is many times greater than that of the other elements present in tissues such as hydrogen, oxygen, and nitrogen. In the second step, the patient is radiated with epithermal neutrons, which after losing energy as they penetrate tissue, are absorbed by the capture agent which subsequently emits high-energy charged particles, thereby resulting in a biologically destructive nuclear reaction.

All of the clinical experience to date with NCT is with the non-radioactive isotope boron-10, and this is known as boron neutron capture therapy (BNCT).

A boron delivery system with high therapeutic efficiency and low adverse effects is crucial for a successful boron neutron capture therapy (BNCT).

Boron cluster-containing redox nanoparticles (BNPs) are promising for enhancing the BNCT performance ²⁾.

The clinical results of BNCT in patients with **Glioblastoma** are similar to those of recent conventional treatments based on radiotherapy with concomitant and adjuvant temozolomide ³⁾.

Of the 180 patients with malignant brain tumors whom we treated with boron neutron capture therapy (BNCT) since 1968, only one (0.56%) developed multiple radiation-induced meningiomas. The parasagittal meningioma that had received 42Gy (w) for BNCT showed more rapid growth on Gd-enhanced MRI scans and more atypical features on histopathologic studies than the temporal convexity tumor that had received 20Gy (w). Long-term follow up MRI studies are necessary in long-survivors of malignant brain tumors treated by BNCT ⁴⁾.

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