Towards Next Generation Cancer Therapy: In vivo Dosimetry Studies of Boron Neutron Capture Therapy using Protist Models

Kollipara, Veenadhari
Krishna Kumar, Nitya

Boron Neutron Capture Therapy is an emerging cancer radiation therapy employing the use of high energy alpha particles produced in the reaction between thermalized neutrons and Boron-10 to selectively target and kill tumor cells while sparing healthy tissue. Existing cancer treatment modalities (chemotherapy, radiation therapy, surgery, and immunotherapy) are unable to destroy tumor cells while minimizing the adverse effects on normal tissue. BNCT provides a promising option for targeted radiation therapy. The treatment was first introduced in the 1930s and clinical trials have been occurring for over 60 years, however there is still no established boron/neutron dosage that provides an optimum mortality of tumor cells. Therefore, this research investigates the mortality rates due to varying dosages of neutron radiation of multiple protists used as models for tumor cells. We hypothesized that as neutron dosage increases, cell mortality will also increase. Three trials were run, using a fully functional IEC-9000 nuclear fusion reactor, for 5 different organisms (Peranema, Blepharisma, Paramecium bursaria, Euplotes, and Euglena) in 6 neutron doses (10, 20, 30, 40, 50, 60 min), resulting in a total of 90 tests. Each test had a set boron concentration of 0.0000085 g/mL. The post radiation data of Euplotes, Euglena, and Blepharisma showed a strong, positive, linear relationship between neutron dosage and cell mortality. However, Paramecium b. showed zero correlation between dosage and cell mortality and Peranema samples found no visible living or dead organisms. According to the data, the organisms may have disintegrated due to the BNCT treatment. This study emphasizes the need for balanced optimal boron/neutron dosage, so that BNCT can become a more effective treatment.

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