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Beyond Proton Minibeam Therapy: Exploring Boron-Proton-Capture effect for Enhanced Tumor Control

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The primary aim of radical radiotherapy is to effectively treat tumors while minimizing damage to normal tissues. Hadron therapy, utilizing heavy particles such as protons, alpha particles, and carbon ions, provides a unique advantage over conventional photon therapy, which can be increased by the use of spatial fractionation. The focus of this research project is to further enhance the effect of Proton Minibeam Therapy by the additional use of Boron Proton Capture therapy aiming to enhance the effectiveness of treatment with respect to tumor control. The boron-proton interaction generates short-lived excited states, releasing alpha particles with higher energy than conventional protons, intensifying damage to tumor cells while preserving healthy tissue.

The methodology consists of introducing boron compounds into tumor cells and then irradiating them with proton particles. Subsequently, the ionizing radiation induced foci (IRIF) staining tests, capture the interaction and alpha particle emission, employing high-resolution confocal microscopy for analysis. Another experimental phase involves the micronuclei test, evaluating and comparing the radiotoxicity of proton and alpha particles in terms of inducing micronuclei in cells. The cell line used in this research project is the PANC1 cell line.

Preliminary results from ionizing radiation induced foci microscopy demonstrated the successful capture of the interaction between boron compounds and proton particles. However, further improvements in boron compound synthesis are crucial for successful localization within tumor cell nuclei. This ongoing research signifies a notable step toward advancing proton therapy, providing valuable insights into the potential of Boron-Proton-Capture therapy for enhancing tumor control while minimizing the impact on healthy tissues.

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