Microdosimetry and Mechanistic model based analysis of biological effectiveness for boron neutron capture therapy

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Boron Neutron Capture Therapy(BNCT) is a kind of binary therapeutic modality combined with neutron exposure and drug-targeting. The micro-distribution in a cell of the boron contained drug would determine the biological effectiveness considering the short-ranged and high LET secondary particles produced from the neutron capture reaction. However, currently only a constant compound biological effectiveness value is used in clinical treatment. As the knowledge of radiobiology improving, we must acknowledge that the radiation biological effectiveness can be varied with different tumor/normal tissue, different dose, different endpoints and different drugs etc. Therefore, to quantitatively analyze the biological effectiveness of a drug during BNCT would provide a tool to optimize the treatment planning of BNCT.

In this study we will present some results for radiobiological effectiveness of tumor in BNCT, which might be useful for the drug optimization and treatment design. In the work, the Geant4 Monte Carlo toolkit was used to simulate the process of interaction of charged particle with cells. G4DNA Physics list will be used to simulate the micro-sized geometry. To account for the tumor survival curve, the kinetic repair-misrepair-fixation (RMF) model will be used to link double-strand break (DSB) induction and microdosimetry parameter to reproductive cell death. In the talk, we would present the microdosimetry with the micro-distribution of BPA, BSH, and some recent developed boron-drugs. Synergistic effects of multiple dose sources in BNCT will also be discussed in the talk. The work will provide a wonderful tool for radiobiological effectiveness study.

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References

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