cell research

BNCT with Laser-synthesized boron nanoparticles

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Boron neutron capture therapy (BNCT) is one of most appealing radiotherapy modalities. We explore the use of elemental boron nanoparticles (BNPs) fabricated by the methods of pulsed laser ablation in liquids as sensitizers of BNCT.

Depending on conditions of laser-ablative synthesis, the used NPs were amorphous (a-BNPs) or partially crystallized (pc-BNPs) with the mean size of 20 nm or 50 nm, respectively. Both types of BNPs were functionalized with polyethylene glycol polymer to improve colloidal stability and biocompatibility.

The NPs were efficiently absorbed by U87 glioblastoma and SW-620 colorectal adenocarcinoma cells and did not initiate any toxicity effects up to concentrations of 100 μg/mL, as followed from results of MTT and clonogenic assay tests.

The cells with BNPs incubated at 10B concentration of 40 μg/mL were then irradiated with a thermal neutron beam for 30 min. We found that the presence of BNPs led to a radical enhancement of cancer cell death, namely a drop of colony forming capacity of SW-620 cells down to 12.6% and 1.6% for a-BNPs and pc-BNPs, respectively, while the relevant colony-forming capacity for U87 cells dropped down to 17%. The effect of cell irradiation by neutron beam uniquely was negligible under these conditions.

To estimate dose and regimes of irradiation for future BNCT in vivo tests, we studied bio-distribution of boron under intratumoral administration of BNPs in immunodeficient SCID mice and recorded an excellent retention of 10B in tumor.

The obtained data unambiguously evidenced the effect of a neutron therapy enhancement, which can be attributed to efficient B NPs-mediated generation of α-particles.

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