

MASUTANI-1: For the preclinical investigation of biological effectiveness of accelerator-based BNCT system.

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Boron neutron capture therapy (BNCT) is based on nuclear reaction between boron-10 and thermal neutron causing alpha particle and lithium nuclei with high energies. Boron compounds such as ¹⁰B-boronophenylalanine (BPA) are preferentially incorporated into cancer cells.

As neutron sources, several types of accelerator-based BNCT systems have been developed recently and installed in hospitals. The features of neutron beam are different among facilities depending on target types and acceleration energies. A BNCT system with a linear accelerator and the solid-lithium target with irradiation beam of vertical downward direction (CICS-1) has been installed in National Cancer Center Hospital (NCCH). When relative biological effectiveness (RBE) of the neutron free-beam for the BNCT system in NCCH was measured as cancer cell survivals, the RBE was in the expected range. We have investigated and evaluated biological effectiveness of the BNCT system in NCCH using cells and mice. The middle-sized animals could not be used because of radio-activation of the bodies and medical regulatory aspects. There are limitations of using mouse models for the evaluation of biological effect in beam-depth direction, because the body thickness of mice is approximately 2 cm, but those of human patients are mostly more than 10 cm. To overcome this difference, we developed an experimental system utilizing three mice positioned in a stratified manner to obtain thickness of approximately 6 cm. We then measured the crypt regeneration ability of small intestine at day 3.5, which has been used to characterize biological effects of photon and particle beams, such as proton and carbon-ion. We investigated the concept and applicability of the above new mouse model for evaluation of biological effectiveness of beam-depth direction of BNCT systems. This analysis system with mice aligned in a stratified manner with regeneration ability of small intestine may be useful for comparisons among facilities of different types of neutron beams. Acknowledgements for collaboration: Satoshi Nakamura, Yuka Sasaki, Takae Onodera, Hiroyuki Okamoto, Kenji Shimada, Hiroshi Igaki, Yoshio Imahori