OIST OKINAWA INSTITUTE OF SCIENCE AND TECHNOLOGY GRADUATE UNIVERSITY
沖縄科学技術大学院大学

Seminar

Hosted by Advanced Medical Instrumentation Unit

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Comparable senescence induction in 3D human cartilage model by exposure to therapeutic doses of X-rays or C-ions

Purpose: Particle therapy using carbon ions (C-ions) has been successfully used in the treatment of tumors resistant to conventional radiation-therapy. However, the potential side effects to healthy cartilage exposed to lower linear energy transfer (LET) ions in the beam track prior the tumor, have not been evaluated. The aim of this study was to assess the extent of damage following C-ions irradiation in a 3D cartilage model close to human homeostasis.

Materials and Methods: Primary human articular chondrocytes from a healthy donor were cultured in a collagen scaffold to construct a physioxic 3D cartilage model. Monolayer 2D culture was used as a reference. Cells were irradiated with a single dose of monoenergetic C-ions beam with a linear energy transfer of approximatively 30 keV/µm. This LET corresponds to the entrance channel of C-ions in the shallow healthy tissues before the spread-out Bragg peak (~100 keV/µm) during hadrontherapy protocols. The same dose of X-rays was used as a reference. Survival, cell death and senescence assays were performed.

Results: As expected, in 2D culture, C-ions were more efficient than X-rays in reducing cell survival with a relative biological effectiveness of 2.6. This was correlated with a stronger radiation-induced senescence (two-fold) but not to higher cell death induction. Interestingly, this differential effect was not reflected in 3D. Indeed, both ionizing radiations induced comparable rate of senescence induction in 3D.

Conclusions: The higher biological effectiveness of C-ions compared to low-LET radiations taken into account in treatment planning systems might be misevaluated using 2D culture experiments. Radiation-induced senescence is an important factor of potential cartilage attrition. The present data should encourage the scientific community to use relevant models and beams to improve the use of charged particles with a better safety for patients.

October 27, 2016 (Thursday)
2:00pm
C016 Seminar Room - Lab 1 Level C