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Drug Delivery System と単色 X 線を用いた新規放射線療法

Novel combination cancer radiotherapy using monochromatic X-rays and drug delivery system.

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Radiotherapy is a major modality used to treat cancer. Despite recent advances in oncology, it is still impossible to cure a number of radioresistant cancers. A radiosensitizer can enhance the effect of radiation and improve the disease prognosis. High-Z elements, such as gold (Z=79), have a high potential of dose enhancement. Gold perfectly absorbs X-rays of a certain range, emitting fluorescent photons. Compton scattering, the emission of Compton and Auger electrons also increase the local effect of radiation. Gold is biologically inert and can be effectively used as a radiosensitizer in the form of nano-particles.

The effects of gold nano-particles were evaluated on human (U251 MG, U343 MG) and rat (C6) glioma cell lines. Electronic microscopy, inductively coupled plasma mass spectrometry (ICP-MS) and MTT assay were used to determine the location, accumulation and toxicity of 8nm and 45nm gold nano-particles, respectively. The radiotherapy enhancement was proved by colony forming (CF) assay after conventional X-ray irradiation at different irradiation and drug doses (Fig.1).

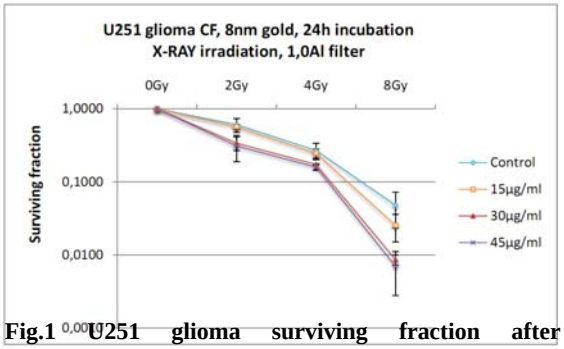

Fig.1 U251 glioma surviving fraction after

Summarizing the obtained data the strategy of combination radiotherapy has been developed. Active tumor targeting is achieved by the use of liposomes with incorporated gold nano-particles and tumor-specific ligands on the surface, providing molecular recognition and attachment to cancer cells. The generation of monochromatic X-rays is achieved by the interaction of the electron beam and the laser with the adjustment of photon energy according to the nature and location of the targeted cancer, providing the efficient amount of fluorescent photons and the specific pathway length of locally emitted electrons, leading to the significant local dose enhancement by gold nano-particles accumulated in tumor cells and to the improvement of the disease prognosis.