Contribution ID: **63** Type: **Invited Technical Oral Communication**

Reduced side effects by proton microchannel radiotherapy –studi in a human skin model

Wednesday, 9 July 2014 08:30 (30 minutes)

We propose a novel strategy to reduce the known side effects of radiotherapy by using proton microchannel irradiation. The goal is to minimize the risk of normal tissue damage by microchannel irradiation, while preserving local tumor control through a homogeneous irradiation of the tumor that is achieved because of beam widening with increasing track length. In order to prove the hypothesis of reduced side effects in normal tissue through microchannel proton irradiation, we report on a comparative study of microchannel and broad beam irradiation of artificial skin tissue.
20 MeV protons were administered to human skin models (EpidermFTTM) in 10 to 180 µm wide irradiation channels at the proton microprobe SNAKE on a quadratic raster with distances of 500 to 1800 µm between each channel (center-to-center) applying an average dose of 2 Gy. For comparison, other samples were irradiated homogeneously by protons at the same average dose. Widened channels as in deeper lying tissues were investigated in skin tissues as well.
Normal tissue viability was significantly enhanced after microchannel proton irradiation compared to homogenous irradiation (~80% vs. ~40% viability (MTT)). Levels of inflammatory markers, such as cytokines and chemokines, were significantly lower in the supernatant of the human skin tissue after microchannel irradiation than after homogeneous irradiation. Furthermore, genetic damage as determined by the measurement of micronuclei in keratinocytes was also significantly reduced after microchannel irradiation compared to homogeneous irradiation (0.015-0.030 micronuclei per divided cell for microchannel vs. 0.070 ± 0.007 MN/divided cell for homogeneous irradiation).

Supported by the DFG Cluster of Excellence: Munich-Centre for Advanced Photonics.
References: Zlobinskaya, Girst et al., Radiat. Environ. Biophys. 52, 123-133 (2013)

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Session Classification: Session 4 - Nuclear Microprobe Applications: Biology 2