Improvement of Microbeam Radiation Therapy by Combination with Drugs

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Microbeam Radiation Therapy is a new form of radiosurgery first dedicated to the treatment of brain tumors. It uses arrays of synchrotron generated X-rays microbeams of very high doses (typically 625Gy). Microbeams are typically few micrometers large (25μm) and few hundred micrometers spaced (200μm). It has been shown that this particular irradiation geometry spares normal tissues surrounding the tumour, through a rapid repair of normal brain vasculature. Previous experiments have shown that despite a good tumor eradication rate (5/11), a 100μm spacing unidirectional irradiation (skin dose 625 Gy, width 25 μm) was too invasive for normal tissue. On the contrary, a 200μm spacing unidirectional irradiation preserved healthy tissue with a low tumor eradication rate (2/32) (P. Regnard et al. Radiation Research ,submitted).

The purpose of this study was to enhance the potential of the 200 μm spacing irradiation protocol by combining MRT with drug intratumoral injection. After diagnosis of the tumor by MRI, 9L tumor-bearing rats were laterally irradiated with 51 microbeams (625 Gy, 25μm, 200μm) 14 days after implantation using the Tecomet multislit collimator installed at the ESRF biomedical beamline. 10 μl of gadolinium (Magnevist, Lab. Guerbet) were manually injected at the theoretical center of the tumor, 20 minutes before irradiation.

Control rats displayed a median survival time of 19 days in agreement with literature. There was no significant difference between drug-treated rats and control group. Irradiated animals showed an Increase Life Span (ILS) of 60.5% without long term survivors. Interestingly, the ILS increased to 131.6% and 1/6 rat survived more than one year in case of MRT combined with gadolinium injection. These preliminary results showed that the synergy between gadolinium injection (acting as a dose enhancer) and MRT improved significantly the lifespan of tumor bearing rats (more than a factor 2). Another set of experiments was performed recently (cross fired irradiation, 460 Gy, 200μm spacing, 25μm width, 10 μl of gadolinium) and survival curves are underway.

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