Microbeam Radiation Therapy: Principle and Current Status of Pre-clinical Studies

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Microbeam Radiation Therapy (MRT) is a proposed radiotherapy technique accomplished by cross-firing a lesion with arrays of parallel, microscopic x-ray beams. The spatial micro-fractionation of the absorbed dose outside the target area that results from such an irradiation has been shown to considerably reduce the damage to normal tissues, even though the absorbed dose in each individual micro-beam was much higher than the threshold absorbed dose for tissue necrosis from continuous-field irradiation. From this observation it was hypothesized that MRT could be useful for radiotherapy of brain tumors in small children. Synchrotron x-ray sources are today the only sources that can produce microbeam arrays with sufficient energy and photon flux rate to allow MRT. Following experiments on 9L gliosarcoma bearing rats at Brookhaven National Laboratory, a proposal to build an MRT irradiation facility was therefore submitted to the directorate of the European Synchrotron Radiation Facility (ESRF). As a result, a small animal microbeam irradiation facility has been commissioned and is in use for preclinical MRT studies. We will present the principle for MRT, in particular with regard to normal tissue tolerance, the small animal irradiation facility at the ESRF, and the present status of preclinical MRT studies.